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AIR QUALITY MONITORING REPORT FOR THE SUDBURY AREA

(1975)

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1976
MOE

Ontario

Ministry
of the
Environment

R. E. Moore
Director
Northeastern Region

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Air Quality Monitoring Report
For the Sudbury Area (1975)

By

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and

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Ontario Ministry of the Environment

Northeastern Region

May, 1976

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I. Introduction:

The ambient air quality in the Sudbury area has been monitored by the Ontario Ministry of the Environment for a number of years. In the early 1970's the monitoring program consisted principally of the sulphur dioxide monitoring network. Since then the ambient air quality monitoring network has expanded considerably in order to measure the levels of other air pollutants in the Sudbury area.

In 1975 the network comprised the following: 16 continuous SO_2 monitors, 3 coefficient of haze measuring instruments, 13 sulphation plates, 2 fluoridation candles, 9 high volume air samplers, 22 dustfall jars and 4 instruments to monitor separately the levels of carbon monoxide, total hydrocarbons, oxides of nitrogen and ozone at Ash Street in Sudbury. The approximate locations of the monitoring sites are shown in figures 1 and 2 on pages 64 and 65 .

In this report the data collected from these monitoring devices for 1975 are reported together with summaries of the available data from previous years (in most cases since 1972) in order to present a comprehensive picture of the ambient air quality in the Sudbury area over that time period. Whenever possible annual means were computed in order to determine variations in the levels of various air pollutants at the different locations throughout the area. Numerous figures are included in the appendix in order to present these variations as a function of time.

The data indicate that the levels of sulphur dioxide and particulate matter have generally decreased since 1972 in the Sudbury area. The number of occasions for which the Air Pollution Index at Ash Street has exceeded the level of 32 has gone down considerably over that time period. The levels of the heavy metals, copper and nickel, in suspended particulate matter have also decreased and are well within the criteria established by the Ministry. Finally, the levels of the urban pollutants measured at Ash Street were also found to be within the government criteria.

II. Sulphur Dioxide Levels In The Sudbury Area:

Sulphur dioxide emissions from the Sudbury area smelters of the Inco Ltd. and Falconbridge Nickel Mines have been monitored by various Departments and Ministries of the Ontario Government since the mid-1940's. The modern monitoring network initially consisted of 5 Thomas autometers in 1953 located at Burwash, Skead, Grassy Lake, Garson and Lake Penage. Since 1953 the network has been expanded into areas where vegetation was being injured by sulphur dioxide. During 1975 the network consisted of 16 stations. The locations of these stations and of the smelters are shown in figure 1 on page 64. The network comprised 13 Davis conductivity instruments and 3 Beckman coulometric instruments. The Davis instruments were all located at stations well removed from other sources of pollutants in order to avoid interferences in the measuring cell. The Beckman instruments, on the other hand, respond solely to sulphur dioxide and are thus routinely used in urban areas without fear of interference from other air pollutants. These latter instruments are located at Ash Street in Sudbury, in the town of Coniston (both stations are Air Pollution Index stations), and on Caswell Drive (Lockerby Plaza) in Sudbury. This last station went into operation in May of 1975.

The Kukagami Lake station was shut down in the fall of 1974 and in July of 1975 a station was installed at Chiniguchi Lake. Another station was installed at Lake Temagami (Bear Island) in June 1975. All of the stations, except for Chiniguchi Lake, Grassy Lake and Lake Temagami are winterized and are operated on a year round basis.

A) Sulphur Dioxide Levels - 1975 (May - October):

In this section the data for all stations in the Sudbury area except Ash Street, Coniston and Lockerby are reported for the growing season, i.e. from May to October. At this point it is appropriate to recall that INCO was on strike from July 8 to July 21 and that Falconbridge was on strike from August 21 to November 10 during 1975.

In the following table the number of days the recorders were operated as well as the number of days some level of SO_2 was recorded and the maximum 1 hour average concentrations are listed.

Station	Operative Days (May to October)	No. of Days With SO_2		Max. 1 Hr. Conc. (ppm)	Date
		Total	%		
Lake Penage	181	49	27	0.67	June 29
Burwash	184	98	53	0.37	Sept. 27
Callum	182	112	61	0.41	Aug. 28
Skead	169	104	61	1.75	Sept. 20
Hanmer	171	122	71	0.56	Sept. 3
Rayside	181	81	45	1.00	Aug. 23
Garson	162	105	65	1.05	Aug. 16
Morgan	178	33	18	0.33	Oct. 12
St. Charles	176	85	48	0.25	Aug. 7
Grassy Lake	151	83	55	0.21	July 1
Verner	177	96	54	0.28	Sept. 14
Chiniguchi Lake*	81	35	43	0.26	Sept. 3
Lake Temagami**	133	53	40	0.11	Aug. 13
TOTAL	2,126	1,056			

* Station operated from July to October in 1975
** Station operated from June to October in 1975

The recorders were operated a total of 2,126 days and some level of SO_2 was recorded on 1,056 days. This compares well with the figures from 1974 during which 1,002 days with SO_2 were recorded from a total of 1,968 operative days. The maximum one hour reading was 1.75 ppm and this was recorded at the Skead station on September 20. Recalling that Falconbridge was on strike from August 21 to November 10, eight of the thirteen maximum 1 hour readings recorded during the 1975 growing season, including the 1.75 ppm and 1.00 ppm hourly average values recorded at the Skead and Rayside stations respectively, resulted from emissions from the INCO operations. The maximum 1 hour concentrations recorded on June 29, August 7 and 16 were attributed to emissions from Inco Ltd. through correlations with meteorological data. The maximum concentrations recorded on July 1 and August 13 could not be attributed to a particular source. The highest numbers of days with SO_2 were recorded at the Hanmer, Garson, Callum and Skead stations as was also the case in 1974.

In the next table the number of hours of sulphur dioxide recorded at each of the 12 stations during the growing season together with the percentage of valid data are shown. The number of hours above the criteria are also shown. In Ontario, the Ministry of the Environment criteria for SO_2 are 0.25 ppm for a 1 hour average and 0.10 ppm for a 24 hour average.

Station	% Valid Data	Total # of Readings	SO_2 Readings	No. of Times Above Criteria	
				1 Hr.	24 Hr.
Lake Penage	98	4333	328	8	1
Burwash	99	4393	1014	5	NIL
Callum	99	4373	815	8	NIL
Skead	92	4074	1113	59	3
Hanmer	92	4071	1211	18	NIL
Rayside	98	4341	734	7	1
Garson	91	4020	710	52	3
Morgan	97	4269	227	2	NIL
St. Charles	95	4217	692	NIL	NIL
Grassy Lake	82	3604	651	NIL	NIL
Verner	96	4237	649	1	NIL
Chiniguchi Lake*	67	1981	199	1	NIL
Lake Temagami**	75	3190	394	NIL	NIL
TOTAL		51,103	8,737	161	8

*Station operated from July to October in 1975
**Station operated from June to October in 1975

A total of 8,737 hours of SO_2 were recorded during a total sampling time of 51,103 hours. This indicates that some level of SO_2 was being recorded approximately 17% of the sampling time. During similar periods in 1974 and in 1973, SO_2 was recorded during 15% and 24% of the sampling time respectively. Valid data were collected on the average over 90% of the time during the past 3 seasons. The 1 hour criterion was exceeded on 161 occasions whereas the 24 hour criterion was exceeded 8 times. In both instances the majority of the excessive readings were recorded at the Skead and Garson stations.

This is illustrated in table 1 on page 32 where the distribution of the SO_2 hourly readings collected during 1975 are shown. The concentration ranges are all in parts per million (ppm). Six readings were above 1.00 ppm while 26 were above 0.50 ppm and 161 were above 0.25 ppm. Approximately 98% of the hourly readings were below the 0.25 ppm level. During the same period last year, as shown in table 2 on page 33, 2 readings were above 1.00 ppm while 50 were above 0.50 ppm and 249 were above 0.25 ppm. About 97% of the hourly readings were below the 0.25 ppm level. Thus there appears to have been a reduction in the number of readings in the 0.25+ ppm and 0.50+ ppm range during 1975. However closer inspection of the data for both years indicates that this difference stems from a significant reduction of these excessive readings at the Skead station during 1975. This probably resulted from the extended strike at Falconbridge Nickel Mines during the period from August 21 to November 10. This is substantiated by the fact that in past years the majority of the excessive readings recorded at the Skead station during the growing season occurred during August, September and October.

B) Sulphur Dioxide Levels - 1975 (January - December):

In this section the data for all stations in the Sudbury area that are operated on a year round basis are reported for the entire year. Thus the data will include that of the Ash Street, Coniston and Lockerby stations and will exclude that of the Grassy Lake, Lake Temagami and Chiniguchi Lake stations which are operated from May to October only.

In the following table the percentage of valid data recorded at the stations as well as the annual average levels of SO_2, the 24 hour and the 1 hour maximum values together with the number of times above the criteria are shown for 1975. The annual criterion for sulphur dioxide is 0.02 ppm.

Station	% Valid Data	Annual Avg. Conc. (ppm)	24 Hr. Max. (ppm)	1 Hr. Max (ppm)	No. of Times Abov Criteria		
					1 Hr.	24 Hr.	1 Yr.
Lake Penage	97	.004	.11	.67	11	1	NIL
Burwash	99	.008	.12	.73	41	2	NIL
Callum	99	.009	.09	1.48	26	NIL	NIL
Skead	87	.016	.20	1.75	86	5	NIL
Hanmer	94	.010	.10	.66	51	NIL	NIL
Rayside	97	.007	.13	1.00	21	1	NIL
Garson	92	.012	.16	1.05	71	3	NIL
Ash Street	94	.028	.14	1.07	53	7	1
Morgan	94	.004	.14	.94	8	1	NIL
St. Charles	95	.005	.08	.55	5	NIL	NIL
Coniston	95	.014	.15	.83	60	3	NIL
Lockerby	75	.009	.12	.66	26	1	NIL
Verner	96	.004	.04	.29	3	NIL	NIL
TOTAL					462	24	1

On the average the recorders collected valid data well over 90% of the time during 1975. The 1 hour criterion was exceeded on 462 separate occasions whereas the 24 hour criterion was exceeded on 24 occasions. Again the majority of the excessive readings were recorded at the Skead station, followed by Garson, Coniston, Ash Street and Hanmer. The annual criterion was exceeded only at the Ash Street station during 1975.

The annual average SO_2 concentrations and the number of hours exceeding 0.25 ppm are summarized in table 3 on page 34 for stations in the Sudbury area for the years 1971 - 1975. The annual average concentrations decreased substantially as of 1973 at most stations with the exception of Burwash and St. Charles where the annual average concentrations have increased since 1972. This is consistent with the closing down of the INCO smelter at Coniston and of the pyrrhotite plant at Falconbridge in April of 1972, and with the introduction of the 1250 foot stack at Copper Cliff in August of 1972. Since 1973 the annual average concentrations for most stations have remained steady with the highest values being recorded at Ash Street and Skead.

The number of hours with average SO_2 concentrations exceeding 0.25 ppm decreased markedly from 1971 to 1972 presumably because of the significant changes in the smelting processes noted above. The most significant reductions in the number of hours exceeding the criterion occurred at Skead, Ash Street and Garson. The year 1973 was an exceptional year as far as atmospheric dispersion of sulphur dioxide was concerned since the total number of hours above 0.25 ppm was the lowest for the 5 years reported above, even with the addition of 2 stations to the monitoring network. In 1974 the total number of hours above 0.25 ppm increased to 519. Marked increases were noted at most of the stations during that year with the exception of St. Charles. The 1975 total went down to 462 hours above 0.25 ppm and this mainly resulted from marked decreases in the levels at Skead and Ash Street. Some of the more distant stations like Burwash, Callum and St. Charles have been recording a slight increase in the number of hours above the criterion since the introduction of the 'superstack' in 1972.

Table 4 on page 35 summarizes the distribution of the sulphur dioxide hourly readings recorded during 1975. Approximately 99.5% of the hourly readings were below the 0.25 ppm level. Of the 462 readings exceeding 0.25 ppm, 157 were above 0.40 ppm and 305 were between 0.26 and 0.39 ppm. During the same period last year, as shown in table 5 on page 36, about 99.4% of the hourly readings were below the 0.25 ppm level. Of the 519 readings above 0.25 ppm, 200 exceeded 0.40 ppm and 319 were between 0.26 - 0.39 ppm. Hence the number of readings in the 0.25+ range decreased substantially from 1974 to 1975. As mentioned earlier this resulted primarily from the reduction of excessive readings at the Skead station during 1975.

C) Source Identification For SO_2 Incidents - 1975:

Through correlations with the available meteorological data, an attempt was made at determining the source(s) of each incident for which the recorded ground level concentrations of SO_2 exceeded the hourly criterion during 1975 at the 16 monitoring stations in the Sudbury area. Of the total number of hours during which the criterion was exceeded, approximately 49% of the readings were attributed to sulphur dioxide emissions from INCO, whereas 38% were attributed to the emissions from Falconbridge. The remaining 13% of the excessive readings could not be associated with a particular source.

For sulphur dioxide concentrations exceeding 0.50 ppm for a 1 hour average, INCO appeared to be responsible for 39% of the readings whereas Falconbridge was responsible for 55% of the readings. Again the remaining 6% could not be attributed to a particular source.

The excessive readings assigned to INCO had an average duration of 2.6 hours and an average concentration of 0.38 ppm. The excessive readings attributed to Falconbridge had an average concentration of 0.42 ppm and an average duration of 2.5 hours.

Thus in 1975, it would appear that both INCO and Falconbridge equally shared responsibility for the total number of hours with sulphur dioxide levels exceeding 0.25 ppm if we allow for the Falconbridge strike from August 21 to November 10. It would also appear that the incidents attributed to Falconbridge tend to be of a greater intensity on the average than those attributed to INCO.

D) Sulphation Rates:

During 1975 the sulphation rate survey consisted of 13 lead peroxide plates distributed in and around the city of Sudbury and Copper Cliff. The plates monitor the rate of formation of sulphur trioxide and hence give an indication of the levels of sulphur dioxide in the ambient air. The sulphation rates are expressed in milligrams of $SO_3/100\ cm^2$ of exposed plate surface/day. The plates are exposed to the atmosphere for a period of 30 days. The Ontario criterion for sulphation is 0.7 mgm $SO_3/100\ cm^2$/day.

The data for sulphation rates during 1975 are presented in table 6 on page 37. The plate locations are identified by their site numbers and street addresses. Their approximate locations are shown in figure 2 on page 65. From the table it can be observed that during 1975 only 2 readings exceeded the criterion. These readings were recorded at the Ash Street station in August (0.92) and at the Nickel Street station in February (0.95). The mean sulphation rates for each month at each station were computed and the results are presented in figure 3 on page 66. The rates were generally higher during the period January to May and varied somewhat during the rest of the year.

In the following table the annual mean sulphation rates and the number of times the rates exceeded the present criterion of 0.7 mgm $SO_3/100\ cm^2$/day are presented for the years 1971 to 1975.

Location	Annual Mean (mgm SO_3/100 cm^2/day)					No. of Times Above The Criterion				
	1971	1972	1973	1974	1975	1971	1972	1973	1974	1975
Ash Street	1.51	0.88	0.41	0.41	0.51	8	6	1	1	1
19 Lisgar Street	—	0.44	0.43	0.44	0.45	-	1	1	1	NIL
1002 Auger Street	1.27*	0.87	0.49	0.25	0.25	3	5	1	NIL	NIL
43 William Street	0.97*	0.73	0.39	0.21	0.19	2	5	1	NIL	NIL
118 Cedar Street	1.23*	0.75	0.46	0.25	0.21	2	6	1	NIL	NIL
555 LaForest Street	0.87**	1.10	0.15	0.26	0.24	1	5	NIL	NIL	NIL
Marion-McNaughton Sts.	0.94*	0.60	0.36	0.19	0.20	3	4	NIL	NIL	NIL
Kirkwood Dr. - Ramsey Lk. Rd.	0.88*	0.59	0.38	0.21	0.16	2	4	NIL	NIL	NIL
1525 Southview Dr.	0.88*	0.75	0.41	0.27	0.21	2	5	NIL	1	NIL
55 Tuddenham Ave.	1.00*	0.75	0.51	0.26	0.23	2	5	1	NIL	NIL
88 Second Ave.	0.85*	0.55	0.36	0.20	0.17	2	3	NIL	NIL	NIL
51 Nickel Street	1.04*	1.13	0.60	0.42	0.45	3	9	5	2	1
3 Oliver Street	1.09*	0.76	0.47	0.25	0.27	3	5	3	NIL	NIL
TOTAL						33	63	14	5	2

*Data for a 3 month period
**Data for a 1 month period

In general the annual mean sulphation rates decreased significantly after 1972 at all stations. This is further substantiated by the number of times the rates exceeded the criterion. In 1971, 33 readings were excessive. However only 43 months of data were collected during the year. For the other years, 12 months of data were collected at all stations for a total 156 readings per year. In 1972 the criterion was exceeded on 63 occasions. During 1973 the criterion was exceeded on 14 occasions. In 1974 and 1975 the criterion was exceeded on 5 and 2 occasions respectively. The stations at Ash Street in Sudbury and on Nickel Street in Copper Cliff continue to register excessive readings although their frequency has diminished substantially since 1972.

III. Ambient Air Monitoring of Particulates:

The levels of airborne particulate matter have been monitored on a regular basis in the Sudbury area since the early 1970's. The monitoring methods that have been and are currently being used are that of soiling index, high volume sampling and total dustfall.

The soiling index is used to determine the amount of suspended particulates in the air and is set to provide hourly readings which can be transmitted by telemetry (if necessary). The fundamental basis of evaluating the sample is optical. The transmittance of light through both filter and deposit is compared with the transmittance through a clean portion of the filter. This difference in transmittance is converted into units of coefficient of haze (COH) per 1000 linear feet of air passing through the filter. The soiling index is incorporated in the equation used to determine the Air Pollution Index.

The amount of suspended particulate matter in the air is quantitatively determined by sampling a large volume of air with a high volume sampler. Approximately 1.5 cubic meter of air per minute is drawn through a preweighed glass fiber filter. The filter is then weighed to determine the amount of suspended particulates deposited. In this manner the total weight of the suspended particulates per unit volume of air sampled is determined. The elemental composition of the particulates can also be determined by atomic absorption.

The amount of dustfall, comprised of the larger size particulates which settle to the ground under the influence of gravity, is measured by exposing open top plastic containers of specified dimensions (20" high and 5" diameter) to the atmosphere for a period of 30 days. The total dustfall loading is determined by weighing the container before and after exposure. ? The contents of the dustfall jars can also be analyzed for the presence of soluble matter and also for various elements such as heavy metals.

A) Soiling Index:

In the Sudbury district during 1975 the soiling index was monitored at Ash Street and at 19 Lisgar Street in Sudbury and in the town of Coniston. At the Ash Street and Coniston stations readings are taken every hour and are telemetered to Toronto for incorporation into the Air Pollution Index equation for each of the stations. At the Lisgar Street station, samples are taken every 2 hours. The filter tapes are subsequently analyzed by Ministry personnel of the Air Quality and Meteorology Section (Air Resources Branch) in Toronto.

The average monthly coefficient of haze readings are summarized in table 8 on page 38 for 1974 and 1975. As indicated in the table the readings are generally quite low.

The 24 hour and the annual criteria for soiling were not exceeded in either 1974 or 1975 as illustrated in table 7. The yearly group frequency classification for 1974 and 1975 appear in the table below. The readings for the different ranges of the COH readings are hourly readings except for the Lisgar Street station which has 2 hour readings.

Station	Year	0 - .4	0.5 - 1.0	1.1 - 2.0	2.1 - 3.0	Total
Ash Street	1975	7762	445	47	2	8256
	1974	7566	147	11	0	7724
Coniston	1975	6783	535	54	1	7373
	1974	3014	110	3	0	3127
Lisgar Street	1975	3135	382	15	1	3533
	1974	3218	288	18	0	3524

It can be observed that less than 1% of the readings are above 1.0 COH unit. The percentage number of readings above 0.4 COH unit increased at all stations from 1974 to 1975. The increases were 3.0, 5.6 and 2.6% for the Ash Street, Coniston and Lisgar Street stations respectively.

The monthly data for 1975 and 1974 were plotted for each location as shown in figures 4, 5 and 6 on pages 67, 68, and 69, respectively. The most significant feature is the seasonal variation of the COH readings. The monthly averages are generally higher during the fall and winter seasons. This is especially evident for the Ash Street and Coniston stations which show similar variations in the amount of suspended particulates with the time of year. At Ash Street the 1975 values were generally slightly elevated over the 1974 readings. The seasonal variation at the Lisgar Street station differs somewhat from that at the other two locations. The levels at that location during the period January to March are generally lower, relatively speaking, compared to the levels for the rest of the year. The levels during the summer and early fall are approximately the same. From October on, the COH levels increase regularly in much the same manner as at the Ash Street and Coniston stations. This difference in seasonal variations at the Lisgar Street station with the other location probably results from the nature of the sites. The station at Lisgar Street is located in the core of downtown Sudbury whereas the other two stations are located in somewhat less densely populated and travelled areas. This could account for the higher levels of suspended particulate matter at the Lisgar Street station during the summer months owing to greater activity and traffic levels at this downtown location.

The higher levels of COH during the late fall, winter and early spring presumably result from emissions of particulates from domestic heating sources throughout the city. This is substantiated by the incidence of the maximum COH readings during that time period as shown in table 7.

The annual hourly average COH values for the three stations for 1975 were computed and are shown in table 9 on page 39. The data are plotted in figure 7 on page 70. The variations in the levels of suspended particulates are similar at all stations. The levels appear to reach a maximum between 0600 to 1000 hours, fall to a minimum at about 1400 to 1600 hours and gradually increase during the evening hours. This trend in the levels of suspended particulates with the time of day indicates that a build up of particulates occurs during the morning hours. The most favorable dispersion conditions appear to exist from mid-day to mid-afternoon. This is especially evident at the Ash Street station. At the Coniston station there is more variability in the hourly averages during that time period and also later in the day. At the Lisgar Street station, the levels of suspended particulates remain fairly constant after 1600 hours.

B) High Volume Sampling:

During 1975 a total of 9 high volume air samplers were in operation in the Sudbury district. At 3 locations (Ash Street, Lisgar Street and Coniston), the samplers were operated on a year round basis. The sampler at Coniston was installed in February. At the other 6 locations (Burwash, Morgan, Penage, Rayside, Skead and St. Charles) the samplers were operated during the summer period only, i.e. from May to October. The high volume samplers are located adjacent to the continuous SO_2 monitoring stations as illustrated in figures 1 and 2.

The samplers are usually operated for a period of 24 hours every sixth day. At the Coniston station, the high volume sampler ran on a more frequent basis during February, March and April. This sampling schedule was selected in order to acquire enough data to establish a correlation between coefficient of haze and high volume sampling measurements at that location in order to develop the Air Pollution Index equation for that station.

The results of the high volume air sampling measurements for the 9 stations in the Sudbury district during 1975 are presented in tables 10 to 18 (pages 40 to 51). The data presented in these tables were the data available at the time this report was written. All values are in micrograms/cubic meter.

i) Summer Surveys

(a) Total Suspended Particulates (TSP):

The high volume filters from the samplers located at the 6 rural locations were analyzed for total loading and also for total Copper (Cu), Iron (Fe), Nickel (Ni) and Zinc (Zn). The analysis for lead (Pb) was terminated in July. A more detailed presentation of the total suspended particulate (TSP) levels appears in the table below. The Ontario criterion for TSP is 120 ug/m^3 for a 24 hour sampling period. The criterion for a 1 year period is 60 ug/m^3 (geometric mean). The values for 1974 are also presented.

Location	No. of Samples		Geometric Mean (ug/m^3)		Max. 24 Hr. Reading (ug/m^3)		No. of Times Above 24 Hr. Criterion	
	1975	1974	1975	1974	1975	1974	1975	1974
Burwash	22	25	25	30	69	104	NIL	NIL
Morgan	25	29	32	45	260	302	2	4
Penage	19	28	25	19	96	52	NIL	NIL
Rayside	21	24	53	36	129	101	1	NIL
Skead	20	25	33	33	81	124	NIL	1
St. Charles	18	27	34	36	90	63	NIL	NIL
TOTAL	125	158					3	5

In 1974, a total of 158 samples were collected and analyzed for TSP compared to 125 samples in 1975. For both sampling seasons the annual criterion of 60 ug/m^3 (geometric mean) was not exceeded at any location. During 1974 the highest mean was recorded at the Morgan station as 45 ug/m^3 whereas in 1975 the maximum mean was recorded at the Rayside station as 53 ug/m^3. For both years the maximum 24 hour readings were recorded at the Morgan station. The majority of the readings exceeding the 24 hour criterion were also recorded at that station during 1974 and 1975 as indicated in the table. At the Rayside and Skead stations the criterion was marginally exceeded once in both 1975 and 1974.

The excessive TSP readings at Morgan during 1975 and 1974 presumably resulted from dust blowing from nearby fields used for the cultivation of potatoes. This is substantiated by the fact that the station is located on a potato farm site, and that all the excessive readings for both years were recorded during May and June when activity in the fields is at a maximum during the seeding operations.

From the data for total loading it seems that the levels of suspended particulates have remained fairly constant during the past two summer seasons at values well within the annual criterion. The 24 hour criterion was exceeded only on 8 occasions out of a total of 183 samples, and the majority of these high readings resulted from local sources as discussed above.

The geometric means for the May to October sampling periods from 1972 to 1975 for the 6 stations are presented in graphical form in figures 8 to 13. In general the levels of suspended particulates have been decreasing and/or remaining steady since 1972. At most locations the highest geometric means were recorded in 1973. The levels at Rayside have been changing regularly since 1972 with no apparent trend with time. Since 1972 the annual criterion of 60 ug/m^3 was exceeded once at Morgan, Skead and St. Charles.

(b) Elemental Analysis:

The high volume filters were all analyzed for total Cu, Fe, Ni, Pb and Zn. Tables 10 to 15 indicate that the levels of these elements were generally quite low.

In table 19 the number of samples analyzed, the maximum 24 hour values, the existing criteria and the number of times the criteria were exceeded are listed for each element for both 1975 and 1974. At the present time there are no criteria for Fe and Zn. The existing criteria were not exceeded during 1974, whereas the criterion for Pb (5 ug/m^3 for a 24 hour period) was marginally exceeded at Rayside on one occasion during 1975. However, the levels of the Pb were usually below 1.0 ug/m^3 during 1975 at all locations. The high volume filters were not analyzed for that element in 1974 at the locations in question.

The amount of Zn deposited on the filters was generally less than 0.1 ug/m^3 per 24 hour sampling period. The maximum levels recorded at most stations were less than or equal to 0.9 ug/m^3 with the exception of the station at Penage which had a maximum reading of 4.3 ug/m^3 in August. The levels during 1974 were also low with most locations registering maximum 24 hour values of 0.1 ug/m^3 of Zn. The maximum values during 1974 were

5.0 and 1.0 ug/m^3 and were recorded at Rayside and Skead respectively.

The levels of Ni were also generally quite low with most locations recording values less than 0.1 ug/m^3. Filters from the Skead and Rayside stations had the highest levels with 0.3 and 0.2 ug/m^3 respectively. The 1974 levels showed similar trends with maximum values of 0.6 and 0.4 ug/m^3 at Skead and Rayside respectively. However in all instances the levels were well below the criterion.

In general the levels of Fe were higher than those of the other elements at all stations. During 1975 the maximum values ranged from 3.0 to 11.9 ug/m^3. The latter value was recorded at Morgan when the total loading of particulates on the filter was 260 ug/m^3. The levels for 1974 were very similar to those in 1975 with a maximum of 8.6 ug/m^3 at the Morgan station. At the present time, no criterion exists for that element.

Finally, the levels of Cu were also fairly low considering the 24 hour criterion of 50 ug/m^3 for that element. Maximum values ranged from 0.55 to 1.8 ug/m^3 during 1975. Maximum values during 1974 were generally below 1.8 ug/m^3 except for St. Charles where a maximum of 9.2 ug/m^3 was measured. At that station 8 of the 27 values were above 2.0 ug/m^3 during 1974.

In the following table the geometric means were computed for the 6 locations for the sampling periods during 1973, 1974 and 1975.

Location	Element	Geometric Mean (ug/m^3)		
		1973	1974	1975
Burwash	Cu	0.33	0.29	0.16
	Fe	—	0.50	1.30
	Ni	0.003	0.021	0.006
	Zn	0.10	0.0	0.0
Morgan	Cu	0.16	0.32	0.49
	Fe	1.80	0.50	1.0
	Ni	0.013	0.013	0.005
	Zn	0.10	0.0	0.0
Penage	Cu	0.14	0.09	0.23
	Fe	0.80	0.60	0.70
	Ni	0.003	0.011	0.001
	Zn	0.10	0.10	0.0
Rayside	Cu	0.44	0.09	0.87
	Fe	1.30	0.50	1.30
	Ni	0.026	0.049	0.018
	Zn	0.10	0.10	0.0
Skead	Cu	0.24	0.15	0.33
	Fe	2.10	0.70	1.20
	Ni	0.084	0.084	0.015
	Zn	0.10	0.0	0.0
St. Charles	Cu	0.99	1.32	0.30
	Fe	1.30	0.60	1.00
	Ni	0.007	0.004	0.003
	Zn	0.20	0.0	0.0

The means for Pb were not included since data were available for 1975 only. The levels of Cu have been decreasing steadily at Burwash since 1973, whereas the levels have been increasing at Morgan. At the other locations, the geometric means have been fluctuating from year to year. The 1974 mean at St. Charles was the highest for the 6 locations over the past 3 years. The levels of Fe have remained fairly steady at all locations in the past 3 years with slightly lower values in 1974.

The levels of Ni have generally gone down in the past 3 years at all locations. The levels have been consistently higher at Rayside and Skead. The levels of Zn, as indicated earlier, have consistently been low.

ii) Annual Surveys

(a) Total Suspended Particulates (TSP):

A summary of the 1975 and 1974 TSP data is presented in the following table.

Location	No. of Samples		Geometric Mean (ug/m^3)		Max. 24 Hr. Reading (ug/m^3)		No. of Times Above 24 Hr. Criterion	
	1975	1974	1975	1974	1975	1974	1975	1974
Ash Street	57	57	32	42	92 (June)	164 (May)	NIL	1
Coniston	83	—	36	—	117 (July)	—	NIL	-
Lisgar Street	56	55	49	55	117 (May)	205 (May)	NIL	2
TOTAL	196	112					NIL	3

The annual geometric means at Ash Street and Lisgar Street decreased appreciably from 1974 to 1975. The maximum 24 hour readings were all recorded during May, June and July in both years. The 24 hour criterion for TSP was exceeded on 3 occasions during 1974, whereas the criterion was not exceeded in 1975. The annual criterion of 60 ug/m^3 (geometric mean) was not exceeded in the past two years.

The annual geometric means for TSP since 1971 and 1972 for the Ash Street and Lisgar Street stations respectively are presented in graphical form in figures 14 and 15. The means at Ash Street have been decreasing steadily since 1971. The mean values for these years have all been within the criterion. The TSP levels have also been decreasing regularly at the Lisgar Street location. The levels at Lisgar Street exceeded the annual criterion in 1972 and in 1973.

(b) Elemental Analysis:

The filters at Ash Street were analyzed on a routine basis for Arsenic (As), Cu, Fe, Ni, Pb; a few samples were also analyzed for Manganese (Mn) and Vanadium (V). The filters at Lisgar Street were analyzed on a continuous basis for Pb and also for Cadmium (Cd), Mn and V in April and May. At the Coniston site the high volume filters were analyzed for As, Cu, Fe, Ni, and Pb. The data for these 3 locations are presented in tables 16, 17 and 18 on pages 46, 48 and 50.

In the table below, the maximum 24 hour values for each element and the 24 hour criterion for each element are listed.

Location	Element	No. of Samples Analyzed	Max. 24 Hr. Value (ug/m^3)	OME Criterion For 24 Hr. (ug/m^3)	No. of Times Above Criterion
Ash Street	As	34	0.08	25	NIL
	Cu	50	2.0	50	NIL
	Fe	50	4.7	No Criterion	-
	Mn	7	0.04	50	NIL
	Ni	50	1.5	2	NIL
	Pb	57 (57)	0.9 (1.8)	5	NIL
	V	7	0.02	2	NIL
Coniston	As	68	0.11	25	NIL
	Cu	85	7.3	50	NIL
	Fe	83	4.3	No Criterion	-
	Ni	83	0.42	2	NIL
	Pb	78	1.1	5	NIL
Lisgar St.	Cd	8	0.004	2	NIL
	Mn	8	0.05	50	NIL
	Pb	55 (55)	2.0 (1.8)	5	NIL
	V	8	0.04	2	NIL

*Values in parentheses are 1974 data.

The criteria for these elements were not exceeded during 1975. The annual geometric means from previous years for which data were available are shown below. In 1974, the high volume filters were analyzed for Pb only.

Location	Element	Geometric Mean (ug/m^3) 1971	1972	1973	1974	1975
Ash Street	Cu	0.50	0.30	0.20	—	0.32
	Fe	3.8	3.4	1.9	—	1.4
	Ni	0.37	0.15	0.12	—	0.13
	Pb	0.50	0.40	0.40	0.30	0.30
Coniston	Cu	—	—	—	—	0.20
	Fe	—	—	—	—	1.60
	Ni	—	—	—	—	0.05
	Pb	—	—	—	—	0.20
Lisgar Street	Pb	—	1.3	1.0	0.70	0.70

The Pb levels have been higher at the Lisgar Street location due to emissions from automobile exhausts at this downtown location. The Pb levels at Coniston during 1975 were lower than those at Ash Street with a geometric mean of 0.2 ug/m^3.

The annual geometric means for Cu, Fe, and Ni decreased noticeably from 1971 to 1973 at Ash Street. Unfortunately the data for 1974 were not available but it appears that the levels of these metals have remained fairly constant since 1973, with the exception of Cu which has gone up slightly in 1975. At Coniston the levels of Cu and Fe during 1975 were similar to those at Ash Street, whereas the levels of Ni were considerably lower as indicated in the table.

The levels of As measured at Ash Street and Coniston during 1975 were quite low. The maximum 24 hour values were 0.76 ug/m^3 and 1.09 ug/m^3 at Ash Street and Coniston respectively. The 24 hour criterion for arsenic is presently 25 ug/m^3. However the Ministry has recently issued a temporary guideline for maximum allowable concentration of As in air with a revised 24 hour ambient air criterion of 5.0 ug/m^3. The geometric means for the sampling periods were .007 and .006 ug/m^3 respectively at Ash Street and Coniston.

A few high volume filters at Ash Street and Lisgar Street were also analyzed for Mn and V. As indicated in the tables on page 46 and 50 the levels of these elements were generally low with all values less than 0.06 ug/m^3 for a 24 hour sampling period. The same applies for the levels of Cd at Lisgar Street. The 24 hour criteria for Cd, Mn and V are 2.0, 50 and 2.0 ug/m^3 respectively.

C) Dustfall Measurements:

i) Summer Surveys

During 1975 dustfall jars were located at Penage, Burwash, Skead, Rayside, Morgan, St. Charles, Grassy Lake and Chiniguchi Lake for the period May to October. The location of the sites are indicated in figure 1 on page 64. The containers were regularly changed on a monthly basis.

(a) Total Dustfall:

The total dustfall levels for 1975 at the above locations are shown in table 20 on page 53. The dustfall jar at Chiniguchi Lake was installed in July. From the data, the levels of dustfall appear to be highest at Morgan and St. Charles. A breakdown of the means for 1973 to 1975 and of the number of times the criterion was exceeded at these locations during the past 3 years is shown in the table below. The superscripts indicate the number of samples for which the averages were calculated when the number of samples was less than 6.

Location	Mean Dustfall Levels (May to October)				No. of Times Above Criterion (30 Days)		
	1973	1974	1975		1973	1974	1975
Penage	16	9	9		1	NIL	NIL
Burwash	12	6^5	4		NIL	NIL	NIL
Skead	10	7	10		NIL	NIL	1
Rayside	18	9	12		1	NIL	NIL
Morgan	27^4	12	25^5		2	1	2
St. Charles	16	10	31		1	NIL	3
Grassy Lake	17^5	13	8		1	1	NIL
Chiniguchi Lake	—	—	4^4		-	-	NIL
MEAN	16	9	13	TOTAL	6	2	6

During 1975 the mean dustfall levels were higher at Morgan and St. Charles with values of 25 and 31 tons/sq. mile/30 days respectively. The average levels of dustfall for all locations were highest during 1973 at 16 tons/sq. mile/30 days. The average levels decreased in 1974 to 9 tons/sq. mile/30 days and increased to 13 tons/sq. mile/30 days the following year. During the past 3 years and especially during 1975, the majority of occasions for which the 30 day criterion of 20 tons/sq. mile/30 days was exceeded were recorded at Morgan and St. Charles. At these locations, the dustfall jars are adjacent to fields that are actively farmed and also to gravel concession roads. Thus it is believed that the excessive levels recorded at these stations resulted from dust originating from these two sources. The summer of 1975 was an extremely dry season and this probably contributed to the increased occurrence of excessive readings. The dustfall levels at the other locations were in most instances within the established criterion for total dustfall.

(b) Soluble $SO_4^=$ in Total Dustfall:

Lately, there has been increasing concern in the scientific community of acid precipitation in areas where SO_2 is emitted to the atmosphere. This acidic precipitation could presumably result from the scavenging of sulphates by rain, in which case the former would be converted to sulfuric acid. Thus in order to investigate the extent to which the dustfall is comprised of sulphates that could possibly be converted to the acid form, the contents of the dustfall jars in the Sudbury area are routinely analyzed for the presence of soluble $SO_4^=$. The values are reported as a percentage by weight of the collected dustfall. The results for the 1975 summer period are illustrated in table 21 on page 54.

The data indicate that from 4 to 59% of the total dustfall was comprised of soluble sulphates. The highest value was obtained at the Chiniguchi Lake station. The maximum levels of soluble $SO_4^=$ and also the means for the 8 locations of interest during both 1974 and 1975 are shown in the following table. The superscripts are again indicative of the number of values used in determining the average.

Location	Max. Level of Soluble $SO_4^=$ In Total Dustfall (%)		Mean for the Period May to October	
	1974	1975	1974	1975
Penage	30	40	17	17
Burwash	25	41	19^5	24
Skead	34	34	27	19
Rayside	24	17	18	10
Morgan	15	12	11	8^5
St. Charles	12	10	9	7
Grassy Lake	28	26	15	12^5
Chinguchi Lake	-	59	-	29^4

During the past 2 years the maximum reported levels of soluble $SO_4^=$ in total dustfall at all locations have been greater or equal to 10% of the total dustfall. During 1974, the highest mean was recorded for Skead whereas in 1975 the highest means were recorded at Burwash and Chiniguchi Lake. The reporting of the amount of soluble sulphates in total dustfall as a percentage by weight can be misleading if one forgets to consider the total dustfall levels concurrently. An example here are the data for the Chiniguchi Lake station which had the highest value for % soluble sulphate in September (59%). The total dustfall at that location for September was only 2 tons/sq. mile/30 days which when converted to total soluble sulphate yields 1.2 tons/sq. mile/30 days. Hence it was decided to convert the % soluble sulphate data to total soluble sulphate loading in order to avoid erroneous interpretations of the data. The reporting of these values in % values is still valuable in that it can be useful in source(s) identification of the dustfall.

The converted soluble sulphate data are shown in table 22 on page 55. The results indicate that during the 1975 summer period the greatest amounts of soluble sulphates which settled to the ground in the form of dustfall were measured at St. Charles, Skead and Morgan. The levels at the other locations are somewhat lower and appear to be fairly similar. Further studies beyond the scope of this report would be required in order to determine the significance and implications of these results.

(c) Elemental Analysis:

The total dustfall collected at the 8 locations in the Sudbury district during 1975 was also analyzed for Cu, Fe, Ni and Zn. The results are expressed as a weight percentage of the total dustfall and are shown in tables 23, 24, 25, and 26. There are no criteria for the percentage composition of these elements in total dustfall. The data are used to observe relative levels from different locations and trends in the levels as a function of time.

The data for 1975 indicate that the percentage composition of these elements in total dustfall is fairly low. The maximum percentage composition of Cu was 0.77% and was reported at Skead. The highest mean for the period May to October was also reported at Skead at 0.36%. Iron comprised the largest fraction of these elements in the dustfall with values ranging from 0.6 to 11.9%. The dustfall jars at Skead had the highest mean iron content, followed by those at Burwash. St. Charles and Penage had the lowest means during that time period. The levels of Ni were low ranging from 0.01 to 0.50%. Most of the readings were less than 0.10%. The majority of the higher readings were reported at the Skead station. At that location the mean percent nickel in the total dustfall exceeded the means at the other locations. The levels of Zn ranged from .03 to .8 %. The highest levels were also recorded at the Burwash and Skead stations.

Thus the highest mean percentage composition of the above elements in total dustfall were found at Skead and at Burwash during the 1975 summer sampling period.

ii) Annual Surveys

Dustfall jars were also located at various sites in the city of Sudbury during 1975. These jars were also changed on a monthly basis and the sampling was carried out year round. A total of 14 dustfall containers were set out at the locations shown in figure 2 on page 65.

(a) Total Dustfall:

The total dustfall levels for 1975 at the above locations are shown in table 27 on page 60. In general the dustfall levels in and around the city of Sudbury were higher during the period April to August. The average for November was higher than that of the other fall and winter months mostly because of elevated levels in the jar located along Highway 17 West at site no. 15. The annual means for total dustfall for 1973, 1974 and 1975 and also the number of times the monthly and yearly criteria were exceeded during the past 3 years for the 14 locations are indicated in table 28 on page 61. The superscripts indicate the number of samples for which the average was determined when less than 12 samples were available. The monthly criterion is 20 tons/sq. mile/30 days and the annual criterion is 13 tons/sq. mile/30 days.

In the past year dustfall levels above the criterion were consistently measured at the following locations: Cedar Street, Tuddenham Avenue, Second Avenue, Oliver Street (Copper Cliff), Penman Avenue and Highway 17 West. At the Cedar Street location the annual mean has been exceeding the annual criterion since 1973, however the mean did decrease somewhat in 1975 from 23 to 19 tons/sq. mile/30 days. The monthly criterion was exceeded on 8 occasions during 1973 and 1974, and on 4 occasions during 1975. The dustfall levels on Tuddenham Avenue marginally exceeded the annual criterion in 1975 as well as in 1974 and 1973. The monthly criterion was exceeded 3 times in 1975, once in 1974 and 3 times in 1973. This location is adjacent to the Inco Ltd. slag disposal site as shown in figure 2.

Excessive levels were also measured with the dustfall jar on Second Avenue in the Minnow Lake area. The annual criterion was exceeded in both 1974 and 1975 with means of 18 and 17 tons/sq. mile/30 days respectively. The monthly criterion was exceeded 5 times in 1975 and on 2 occasions during 1974. The soil in this particular area is mostly sandy, with a few gravel pits within a radius of two miles from the dustfall jar location. It is believed that the excessive levels resulted from dust blowing in this area. The annual mean for total dustfall at the Oliver Street location (Copper Cliff) for 1975 was 23 tons/sq. mile/30 days, well above the criterion. The means for 1974 and 1973 also exceeded the criterion but were under 20 tons/sq. mile/30 days. The monthly criterion was exceeded 4 times in 1975, twice in 1974 and 6 times in 1973. Probable sources of dust at this site are Inco's tailings and slag disposal areas lying to the west and east sides respectively and low level smelter dust emissions.

In 1974 Ministry personnel installed a dustfall jar on Penman Avenue. This location is not illustrated in figure 2 (site no. 14) but lies east of the city of Sudbury in the direction of the town of Garson. This site is in the vicinity of Inco's Garson flux pit. The annual criterion was marginally exceeded in 1975 with 3 readings exceeding the monthly criterion. The criteria were not exceeded during 1974.

In 1975 a dustfall jar was installed south of Inco's tailings disposal site along Highway 17 West as indicated in figure 2. For the 9 month period during which data were collected the mean dustfall level was 40 tons/sq. mile/30 days, the highest value recorded in the past 3 years for dustfall jars in and around the city of Sudbury. The data in table 27 show that levels as high as 87 tons/sq. mile/30 days were measured at that site. Surprisingly high levels were also reported for the months of November and December. The jar is sufficiently removed from the Highway such that particulate emissions from traffic activity can be ruled out. The monthly criterion was exceeded a total of 6 out of the 9 months of data.

At the other sites where dustfall jars were located, the criteria were not exceeded during the past year and there do not appear to be total dustfall problems at these locations at the present time.

(b) Soluble $SO_4^{=}$ in Dustfall:

The contents of the dustfall jars were also analyzed for soluble $SO_4^{=}$. The data, reported as a weight percent of the total dustfall, are shown in table 29 on page 62. The percentage of soluble sulphates in total dustfall range from 2% to 31%. A summary of the maximum levels and the annual means for 1974 and 1975 is shown in the table below. The mean soluble sulphate loading in tons/sq. mile/30 days for both years was also computed.

Location	Max. Level of Soluble Sulphate In Total Dustfall (%)		Annual Mean %		Mean Soluble Sulphate Loading (tons/sq.mile/30 days)	
	1974	1975	1974	1975	1974	1975
Ash Street	45	31	20	19^{11}	2.0	1.5^{11}
Lisgar Street	28	27	15	14	1.9	1.3
Auger Avenue	24	19	13^{11}	13	1.8^{11}	1.3
William Street	37	23	19	15	1.7	1.2
Cedar Street	18	28	9^{11}	9^{11}	2.1^{11}	1.7^{11}
Laforest Avenue	34	29	17	14^{10}	2.5	1.8^{10}
Marion - M^cNaughton Sts.	31	30	17	18	2.2	1.6
Kirkwood Dr. - Ramsey Lk. Rd.	18	29	14	15	1.4	1.0
Southview Drive	29	25	17	17	1.4	1.2
Tuddenham Avenue	41	22	20	14	2.8	2.1
Second Avenue	22	18	12	9	2.2	1.5
Oliver Street	26	22	15	13	2.5	3.0
Penman Avenue	-	16	-	9	-	1.3
Hwy. 17 West	-	17	-	8^{8}	-	3.2^{8}

At most locations the mean soluble sulphate loading was slightly lower in 1975. The one exception was at the Oliver Street location where the loading increased from 2.5 to 3.0 tons/sq. mile/30 days. During the past year the highest mean soluble sulphate loadings were recorded at the following sites: Hwy. 17 West, Oliver Street and Tuddenham Avenue, whereas in the previous year the sites at Tuddenham Avenue, Laforest Avenue and Oliver Street had the highest means. Except for the site on Laforest Avenue, these sites are the closest locations to the Copper Cliff smelters. At the other locations the mean soluble sulphate loadings ranged from 1.0 to 1.8 tons/sq. mile/30 days. These latter figures compare well with the means recorded at the rural locations (see table 22,page 55).

IV. Air Pollution Index:

The origin and nature of the Air Pollution Index system in Ontario has been well documented in the past and consequently only a brief outline of the system will be presented at this time. The index is intended to be used as an alert system during periods of increased levels of air pollution. It is based on the levels of sulphur dioxide and suspended particulates which are averaged over a 24 hour period. When the index reaches 32, the source(s) of these pollutants are notified that curtailment of their activities will occur if the index continues to increase.

During 1975, there were 2 Air Pollution Index (API) stations in the Sudbury area: Ash Street (Sudbury) and Coniston. The station at Ash Street has been operative since January 1971 while the Coniston station was put into operation in February 1975. At these stations the levels of SO_2 and suspended particulates (coefficient of haze) are monitored with duplicate instrumentation. This provides a continuous basis for comparison of the instruments and also ensures that data will continue to be collected in the event of a failure in one of the instruments. The data are telemetered to Toronto for incorporation into the Air Pollution Index equation.

In the past year the API did not exceed the level of 32 at either Ash Street or Coniston on any occasion. At Coniston and at Ash Street the maximum for the year was 30. The frequency classification of the API values for the stations is shown in the table below for 1975. The values listed below are hourly values.

Station	0 - 15	16 - 31	Total
Ash Street	8000	674	8674
Coniston	6982	180	7162

Approximately 92% of the values at Ash Street were below 16 whereas about 97% of the readings at Coniston were in this same range. Since the installation of the station at Ash Street the index has exceeded or equalled the level of 32 on 34 occasions and the level of 50 on 4 occasions. The breakdown by year is as follows.

Year	Ash Street API Number of Occasions ≥ 32	 ≥ 50
1971	26	3
1972	7	1
1973	NIL	NIL
1974	1	NIL
1975	NIL	NIL

Hence it is clear that the number of instances for which the index exceeded 32 have dramatically decreased since 1972 at the Ash Street station. This is credited primarily to the introduction of the Inco superstack in 1972.

A third API station went into operation in the Sudbury area in January 1976. The station is located on Kennedy Street in the New Sudbury section of the city of Sudbury (see figure 2).

V. Fluoridation Rates:

Fluoridation rates have been measured in the city of Sudbury since 1970 at Ash Street and since 1972 at Lisgar Street. The rates are determined by exposing lime candles to the ambient air for 30 days, in much the same manner that sulphation rates are determined with lead peroxide candles. Fluoridation rates are expressed in micrograms of total fluoride/ 100 cm^2 of limed candle surface/30 days.

The results for 1975 are shown in table 30 on page 63. The fluoridation rates at both locations were quite low for most of the year. However sharp increases in the rates were observed during July, August and September. The annual mean at both locations was 11 **ug** F/100 cm^2/30 days. The annual means for previous years' data were also computed for both stations and are indicated in table 31. The superscripts have the usual meaning. It is observed that the annual means have varied substantially from year to year at both locations. The average levels appear to have been approximately the same at both stations since 1972. The data are graphically represented in figure 16 on page 79. The means for 1975 are the lowest since the candle survey has been established. The monthly averages for fluoridation rates were also determined for both locations from the available data in order to observe the seasonal variations. This data also appears on page 63 in table 32 and 33 and has been plotted as illustrated in figure 17.

At the Ash Street station there is no definite trend in the fluoridation rates with the seasons. However at the Lisgar Street station the rates were definitely more elevated during July and August. At both locations the rates were relatively elevated during the month of February. In the following table the number of times the criterion for fluoridation was exceeded are listed. The Ontario criterion for fluoridation is 40 ug F/100 cm^2/30 days during the period April 15 to October 15 and 80 ug F/100 cm^2/30 days for the period October 16 to April 14. The lower figure in the growing season is based on vegetation damage and secondary effects on animals via forage.

Candle Location	Number of Times Above Criterion					
	1970	1971	1972	1973	1974	1975
Ash Street	NIL	2	NIL	3	NIL	1
Lisgar Street	—	-	-	2	1	1

In all instances the criterion was exceeded during the April to October period only. Since 1970 the criterion was exceeded on 6 occasions at Ash Street. At Lisgar Street, the criterion was exceeded on 4 occasions since 1972.

VI. Urban Pollutants - Ash Street:

A number of urban air pollutants have been monitored by the Ministry of the Environment in the city of Sudbury since the early 1970's. These pollutants include carbon monoxide, total hydrocarbons, oxides of nitrogen and ozone, and are all monitored at the Ash Street station. For some of these pollutants, more than one measurement technique has been used in their detection since the inception of the monitoring program. In this report only the data available from latest measurement techniques will be presented.

A) Carbon Monoxide

At Ash Street, carbon monoxide (CO) is monitored with a Bendix 8501 - 5CA Infrared Gas Analyzer. This instrument utilizes the nondispersive infrared single beam technique with alternate modulation of the sample and reference cells. The principle of measurement is based on CO having a known characteristic absorption spectra in the infrared part of the spectrum. The reference cell is filled with a non-absorbing gas and sealed, and the sample is passed through the sample cell. With no CO present in the sample, the amounts of radiation coupled into the detection chamber from the sample and reference cells will be essentially equal, effectively cancelling and producing no output. When CO is present in the sample, some radiation is absorbed by the CO, causing the inputs to be unequal, and producing an output from the detection chamber. The detection chamber is so designed that the output is proportional to the concentration of CO. The signal generated from the analyzer is telemetered to Toronto on a continuous basis and is also recorded on a strip chart recorder. The instrument range is 0 to 50 ppm.

The number of days of valid data, the total number of hourly readings and the group frequency classification of the hourly readings are shown below for 1972 to 1975. The CO ranges are all in parts per million.

Year	Days of Valid Data	0 - 1	2 - 3	4 - 8	9 - 13	14+	Total
1972	223	2235	2294	466	9	0	5004
1973	133	2934	63	4	0	0	3001
1974	306	6875	171	13	1	0	7060
1975	279	5686	810	41	0	0	6537

The hourly average CO concentrations never exceeded 13 ppm on any occasion during the sampling periods reported above. Well over 90% of the hourly readings were within the 0 - 3 ppm range. During 1972 and 1975 a larger fraction of the total number of readings were within the 2 to 8 ppm range. Various instrumentation problems have resulted in considerable losses in the number of days of valid data. This is especially evident for 1973 when only 133 days of valid data were collected.

Year	Annual Avg. (ppm)	Max. 1 Hr. Avg. (ppm)	Max. 8 Hr. Avg. (ppm)	Number of Times Criteria Exceeded*	
				1 Hr.	8 Hr.
1975	0.7	7 (Jan)	5 (Jan)	NIL	NIL
1974	0.2	10 (Dec)	4 (Dec)	NIL	NIL
1973	0.2	7 (Feb)	3 (Feb)	NIL	NIL
1972	1.8	12 (Feb)	10 (Feb)	NIL	NIL

*Ontario criteria for carbon monoxide:
1 hour average : 30 ppm
8 hour average : 13 ppm

In the table above it is observed that the annual average CO concentration decreased from 1.8 ppm in 1972 to 0.2 ppm in 1973 and 1974. The annual mean increased slightly in 1975 to 0.7 ppm. The maximum 1 hour and 8 hour average concentrations are also listed. The maxima for these time periods were all recorded during the months of December, January and February when domestic fuel consumption is at a maximum. The Ontario criteria are listed below the table. For the data reported here these criteria have never been exceeded. The maximum 1 hour and 8 hour concentrations were 12 and 10 ppm respectively in 1972.

The average monthly CO levels were computed for the years 1972 to 1975. The results are plotted in figures 18 and 19 on page 81 and 82. For 1972 and 1973 data were available to August and June respectively making it difficult to observe seasonal variations. The data for 1974 and 1975 are more complete and indicate higher levels during January and February and also for September to December when fuel consumption is at a maximum. Reduced CO emissions from later model cars may have contributed to lower CO levels in summer months from 1973 to 1975.

The annual hourly averages for 1975 were determined for the 10 months of available data. The results of this exercise are plotted in figure 20 on page 83. The variations in CO levels with the time of day were not very large over this 10 month period. The levels were fairly stable during the early morning hours and fell to a minimum around 0400 to 0600 hours. The average concentrations rose at 0700 and stayed at that level until 1000 hours, then decreased to the early morning levels at about 1100 hours. This increase in the CO levels around 0700 hours is presumably associated with increased automobile emissions during that time of day. From 1100 to 1700 hours the levels of CO were constant. A small rise in the levels occurred at 1800 hours, again probably as a result of automobile emissions during rush hour traffic activities. The levels fell to afternoon values from 1900 to 2000 hours and rose regularly during the late evening to reach a maximum at 2300 hours.

B) Total Hydrocarbons

The amounts of total hydrocarbon in the ambient air at Ash Street are measured with a Beckman Model 108 A Hydrocarbon Analyzer. This instrument uses the flame - ionization method of detection. The method consists of a small hydrogen flame burning in an excess of air and surrounded by an electrostatic field. The pure hydrogen flame contains an almost negligible number of ions. The introduction of mere traces of hydrocarbons into such a flame however produces a large amount of ionization, since during combustion, ionic fragments and free electrons are formed. In the presence of the electrostatic field these charged particles produce an electric current which is directly proportional to the number of carbon atoms in the sample component. The current is then suitably converted and amplified and displayed on a recorder. This method is insensitive to water, CO and CO_2. The instrument at Ash Street has a range of 0 to 20 ppm. The output of the analyzer is not telemetered to Toronto.

In the following table the number of days of valid data, the total number of hourly readings and the group frequency classification for 1974 and 1975 for total hydrocarbons are summarized. The concentration ranges are in ppm.

Year	Days of Valid Data	0-1.0	1.1-1.9	2.0-3.0	3.1-6.0	6.1-9.0	9.1-14.0	14.1-20.0	Total
1974	269	301	3927	1422	48	8	5	1	5712
1975	242	17	1529	2152	1526	173	26	2	5425

The majority of the hourly average readings are within the 1.1 to 3.0 ppm range. In 1975 a larger fraction of the readings were in higher concentration ranges as compared to 1974. However in both years the maximum hourly readings did not exceed 19 ppm. Very few of the total number of readings were within the 0 to 1.0 ppm range. This indicates a fairly constant background level of total hydrocarbons with concentrations greater than 1.0 ppm at Ash Street.

The 1972 to 1974 data together with this past year's data are summarized below. Ontario has no established objectives or criteria for total hydrocarbons at the present time.

Year	Max. 1 Hour Average (ppm)	Max. 24 Hour Average (ppm)	Annual Average (ppm)
1972	11.7	3.5	1.8
1973	7.8	3.1	1.9
1974	19.2 (May)	5.5 (April)	1.8
1975	14.9 (Sept, Oct)	7.9 (Dec)	2.9

The 1975 annual average and the maximum 24 hour average concentration are higher than that of previous years.

The monthly averages for 1974 and 1975 were determined and are shown in figure 21 on page 84 . In 1974 the data for July were missing due to instrumentation problems. The April and November data for 1975 were also missing for the same reason. The data indicate that the monthly averages were generally higher during 1975 especially after April. During 1974 the monthly averages showed little variation indicating a fairly constant level of total hydrocarbons in the ambient air. Significant variations however were observed during 1975 with higher levels being measured after April. With the exception of the very high levels in May and in December, the levels of total hydrocarbons were generally more elevated during the period July to October.

The annual hourly averages were computed for both 1974 and 1975 and the results are illustrated in figure 22 on page 85. The hourly averages were all much higher in 1975. In 1974, there was no discernable pattern with time of day indicating again a fairly constant background level of total hydrocarbons at all hours. During 1975 the levels decreased regularly throughout the early morning hours to a minimum around 1200 hours. Thereafter the levels of total hydrocarbons increased regularly to about 1800 hours, after which they stabilized until 2300 hours. Hence the levels of hydrocarbons were generally higher during the second half of the day.

Summarizing, the levels of total hydrocarbons measured at Ash Street in Sudbury were in general higher in 1975 than during the past years during which data have been collected. The reason for this increase was not determined at this time and no attempt was made at identifying possible stationary sources.

C) Oxides of Nitrogen

At Ash Street the oxides of nitrogen are measured with a Thermo Electron Model 14 B Chemiluminescent Analyzer. The chemiluminescent reaction of nitric oxide and ozone is the basis of the detection technique employed. When these gases interact, light is emitted which is uniquely characteristic of the reaction.

To measure nitric oxide (NO) concentrations, the gas sample is blended with ozone (O_3) in a flow reactor. The resulting chemiluminescence is monitored through an optical filter by a high sensitivity photomultiplier positioned at one end of the reactor. The filter transmittance photomultiplier cathode response limits the optical band width to a narrow range specific to the chemiluminescent reaction of nitric oxide and ozone. To measure oxides of nitrogen (NO_x) concentrations (i.e. NO + NO_2), the sample gas flow is diverted through an NO_2-to-NO converter. The chemiluminescent response in the flow reactor thus becomes linearly proportional to the NO_x concentration entering the converter. NO and NO_x concentrations are alternately measured and stored in electronic circuits. These circuits also automatically subtract the NO concentration from the NO_x concentration and display the NO_2 (NO_x - NO) value continuously.

At the Ash Street station the NO and NO_2 data are telemetered to Toronto on a continuous basis and are also recorded on strip chart recorders. The NO_x data are also recorded on a chart. The range of the analyzer is from 0 to 1.0 ppm.

Initially, NO_2 was monitored at Ash Street in 1973 using the Saltzman method of detection. Due to instrumentation problems only 46 days of valid data were collected over a 4 month period resulting in only 29% valid data. During that time period the average concentration was 0.015 ppm. The maximum 1 hour average was 0.12 ppm whereas the maximum 24 hour average was 0.04 ppm. The Ontario criteria for nitrogen dioxide are 0.20 ppm for a 1 hour average and 0.10 ppm for a 24 hour average.

The levels of NO were initially measured with the chemiluminescent method at Ash Street in April 1975. However, due to instrumentation problems, NO was not monitored from July to October. NO_x was not monitored initially in April also because of instrumentation failures. Since the end of October 1975, NO_x and NO (and consequently NO_2) have been monitored simultaneously with over 97% valid data. Thus only a limited amount of data for 1975 on these pollutants can be reported at the present time.

A summary of the group frequency classification for these pollutants for the period October 29 to December 31, 1975 appears below. The concentration ranges are again in ppm.

Pollutant	Days of Valid Data	0-.01	.02-.03	.04-.06	.07-.10	.11-.20	.21+	Total
NO_x	64	547	612	239	52	41	8	1499
NO	64	1097	260	59	30	32	3	1481
NO_2	61	971	448	37	0	0	0	1456

Approximately 93% of the NO_x readings were below 0.10 ppm whereas roughly 98% of the readings were under the same figure for nitric oxide. All the readings for NO_2 were under 0.6 ppm indicating that the higher levels of NO_x consisted mainly of nitric oxide. This is substantiated by the data plotted in figure 23 on page 86 which illustrates an NO_x event recorded at Ash Street in 1975. During the 20 hour period shown in the plot, the levels of NO_2 varied from .02 to .05 ppm whereas the levels of NO followed closely the levels of NO_x. Over the 2 month period for which data were collected the NO_x events were identical to the one just described, suggesting that the NO_2 levels are normally very low at Ash Street. However more data are required in order to substantiate this observation.

A substantial fraction of the NO_x events recorded from October 29 to December 31 showed peak levels during the late evening and early morning hours as shown earlier in figure 23. Again more data are needed before a trend in the levels of these pollutants with time of day can be determined. The same remark also holds in the determination of a seasonal variation.

In Ontario ambient air quality criteria for nitrogen oxides exist for NO_2 only. The 1 hour and 24 hour average criteria are 0.20 and 0.10 ppm respectively.

Pollutant	Average Conc. (ppm) (Oct. 29 - Dec. 31)	Max. 1 Hour Average (ppm)	Max. 24 Hour Average (ppm)	No. of Times Above Criteria	
				1 Hr.	24 Hr.
NO_x	.028	0.30	0.11	-	-
NO	.013	0.26	0.08	-	-
NO_2	.011	0.06	0.03	NIL	NIL

The above table shows that the maximum recorded levels of NO_2 were very much lower than the criteria. The average concentrations of NO and NO_2 for the period October 29 to December 31 were almost identical. This indicates that under normal circumstances the levels of these substances are about equal and that during an event the high levels of NO_x are almost entirely NO as seen earlier.

D) Ozone

At Ash Street the levels of ozone (O_3) have been monitored since October 1974. The monitoring instrument is the Model 1100 Ozone Meter manufactured by the McMillan Electronics Corporation. This instrument utilizes the photometric detection of the chemiluminescence resulting from the flameless reaction of ethylene gas with O_3. Air and ethylene are drawn into a pyrex reaction chamber that contains an optically flat window mounted at the end of a photomultiplier tube. If any O_3 is present in the sample air stream, the ethylene reacts in a flameless reaction emitting photons of light which are detected by the photomultiplier tube causing the tube signal to increase. This increase in signal current is detected and amplified and converted into an ozone measurement. At the Ash Street station the output of the instrument is telemetered on a continuous basis to Toronto and is also recorded on a strip chart recorder. The range of the instrument is 0 to 500 parts per billion (ppb).

The group frequency classification for O_3 for 1974 and 1975 is as follows:

Year	Days of Valid Data	0-10	11-20	21-30	31-50	51-80	81-150	Total
1974	89	527	441	576	403	13	2	1962
1975	338	1713	2446	1427	1447	448	13	7494

The group classification ranges are in parts per billion (ppb). In 1974 and 1975, 88% and 85% valid data were obtained respectively. During both years the majority of the readings were in the range 0 to 50 ppb. Few readings exceeded the 80 ppb level. The fraction of readings above 50 ppb increased significantly in 1975.

The following table shows the average O_3 concentration for 1974 and 1975 and also the maximum levels observed together with the number of occasions during which the criterion was exceeded.

Year	Average Conc. (ppb)	Max. 1 Hour Average (ppb)	Max. 24 Hour Average (ppb)	No. of Times Above 1 Hour Criterion
1974	20.3	87 (Oct)	41 (Oct)	2
1975	22.3	103 (Aug)	72 (July)	13

It is difficult to compare the results of 1974 with those of 1975 since only 2 months data are available for 1974. Nevertheless, it is observed that the average O_3 concentration for the monitoring periods indicated earlier are fairly similar. The average for 1975 is slightly higher. The maximum 1 hour and 24 hour values are higher for 1975 presumably because higher levels of O_3 are present in the summer than during the fall. The 1 hour criterion of 80 ppb was exceeded twice in 1974 and 13 times in 1975. This is again a reflection of the shorter monitoring period during 1974.

The average monthly O_3 levels measured at Ash Street during 1974 and 1975 are shown in figure 24 on page 87. The 1974 values were slightly higher than their corresponding 1975 values. For both years there was a regular decrease in the average levels of O_3 from October to December. For the other months in 1975, the O_3 levels were low in January but increased as of February. From February to August the levels varied regularly with no apparent seasonal variation.

The annual hourly averages were determined and are illustrated in figure 25 on page 88. The averages for both 1974 and 1975 are shown. O_3 displays a strong diurnal variation for both periods during which the monitoring was performed. This indicates that this variation in the O_3 levels with time of day is fairly representative of the entire year irrespective of the seasons. A minimum in the levels of ozone occurred at approximately 0800 hours, followed by a maximum at about 1400 hours. The hourly averages then decreased steadily until 2400 hours. In 1974, however a secondary maximum occurred at approximately 2100 hours.

A more detailed interpretation of the results is beyond the scope of this report at this time. However a preliminary analysis of the 1975 data seems to indicate that there is a correlation (R=0.8) between the average O_3 levels and the number of hours of bright sunshine on a monthly basis.

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VIII. APPENDIX

Table 1:

DISTRIBUTION OF THE SULPHUR DIOXIDE HOURLY READINGS RECORDED IN THE SUDBURY DISTRICT DURING 1975 (MAY TO OCTOBER)

Station	0.0	.01-.04	.01-.25	.25+	.50+	1.00+ppm
Lake Penage	4005	230	319	8	1	0
Burwash	3379	924	1010	5	0	0
Callum	3558	674	807	8	0	0
Skead	2961	744	1057	59	15	4
Hanmer	2860	1078	1194	18	1	0
Rayside	3607	624	727	7	3	1
Garson	3310	484	661	52	6	1
Morgan	4042	196	225	2	0	0
St. Charles	3525	638	692	0	0	0
Grassy Lake	2953	558	651	0	0	0
Verner	3588	619	647	1	0	0
Chiniguchi Lk.*	1782	162	198	1	0	0
Lake Temagami**	2796	325	394	0	0	0
TOTAL	42,366	7,256	8,582	161	26	6

* Station Operated from July to October, 1975.

**Station Operated from June to October, 1975

Table 2: **DISTRIBUTION OF THE SULPHUR DIOXIDE HOURLY READINGS RECORDED IN THE SUDBURY DISTRICT DURING 1974 (MAY TO OCTOBER)**

Station	0.0	.01-.04	.01 - .25	.25+	.50+	1.00+ppm
Lake Penage	3727	566	632	2	0	0
Burwash	3264	336	429	6	0	0
Callum	3746	468	629	20	3	0
Skead	3168	636	1014	126	31	1
Hanmer	3485	676	835	33	9	1
Rayside	3384	797	837	5	0	0
Garson	3439	708	885	45	3	0
Morgan	3597	457	471	5	2	0
St. Charles	3497	559	612	0	0	0
Grassy Lake	3048	562	630	3	1	0
Verner	3532	122	147	0	0	0
Kukagami Lake	2037	224	365	4	1	0
	39,924	6,111	7,486	249	50	2

Table 3:

ANNUAL AVERAGE SO_2 CONCENTRATIONS AND THE NUMBER OF HOURS ABOVE 0.25 ppm RECORDED AT THE SUDBURY DIST. STATIONS FROM 1971 to 1975

	Annual Average SO_2 Concentrations (ppm)					Number of Hours Above 0.25 ppm				
Station	1971	1972	1973	1974	1975	1971	1972	1973	1974	1975
Lake Penage	.007	.009	.003	.005	.004	28	18	8	16	11
Burwash	.006	.001	.008	.011	.008	12	3	3	46	41
Callum	.013	.007	.006	.008	.009	38	12	13	40	26
Skead	.045	.025	.013	.018	.016	242	97	40	163	86
Hanmer	---	---	.005	.010	.010	--	--	5	60	51
Rayside	.011	.006	.006	.005	.007	45	22	27	21	21
Garson	.031	.013	.007	.010	.012	138	57	26	52	71
Ash Street	.053	.028	.017	.033	.028	377	164	42	81	53
Morgan	.006	.003	.004	.004	.004	21	16	1	7	8
St. Charles	.002	.005	.005	.005	.005	0	0	2	1	5
Coniston	---	---	.020*	013**	.014	--	--	27*	40**	60
Lockerby	---	---	---	---	.009+	--	--	--	--	26+
Verner	---	.006+	.004	.003	.004	--	4+	1	1	3
					TOTALS	901	393	195	528	462

* Data for 4 months only

** Data for 9 months only

+ Data for 8 months only

Table 4:

DISTRIBUTION OF THE SULPHUR DIOXIDE HOURLY READINGS RECORDED IN THE SUDBURY DISTRICT DURING 1975

Station	0.0-0.10	0.11-.25	0.26-.39	.40+ppm	TOTAL
Lake Penage	8467	70	6	5	8548
Burwash	8565	102	29	12	8708
Callum	8590	104	22	4	8720
Skead	7387	217	41	45	7690
Hanmer	8133	118	37	14	8302
Rayside	8421	86	18	3	8528
Garson	7863	162	49	22	8096
Ash Street	7914	348	38	15	8315
Morgan	8279	25	4	4	8312
St. Charles	8312	40	4	1	8357
Coniston	8141	135	38	22	8336
Lockerby*	4370	62	17	9	4458
Verner	8413	18	2	1	8434
TOTAL	102,855	1487	305	157	104,804

* This Station Went Into Operation in May of 1975.

Table 5: DISTRIBUTION OF THE SULPHUR DIOXIDE HOURLY READINGS RECORDED IN THE SUDBURY DISTRICT DURING 1974

Station	0.0 - 0.10	0.11 - .25	0.26 - .39	.40+ppm	TOTAL
Lake Penage	8219	88	9	7	8323
Burwash	7462	102	32	14	7610
Callum	7987	102	28	12	8129
Skead	8175	282	83	80	8620
Hanmer	8193	133	31	29	8386
Rayside	8376	60	18	3	8457
Garson	8306	152	40	12	8510
Ash Street	7556	395	50	22	8032
Morgan	8217	32	5	2	8256
St. Charles	8041	32	1	0	8074
Coniston	6171	123	21	19	6334
Verner	7656	29	1	0	7686
TOTAL	94,359	1,530	319	200	96,417

Table 6:

SULPHATION RATES ON THE LEAD PEROXIDE PLATES IN THE CITY OF SUDBURY DURING 1975

(ALL VALUES IN MGM $SO_3/100\ CM^2/DAY$)

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Ash Street	.47	.59	.39	.68	.56	.24	.45	.92	.41	.45	.50	.46
2	14 Lisgar Street	.56	.56	.41	.45	.61	.19	.43	.57	.28	.38	.51	.42
3	1002 Auger Street	--	.26	.27	.30	--	.29	.30	.41	.16	.17	.20	.13
4	43 William St.	.32	.24	.18	.21	.15	.12	.17	.29	.10	.17	.17	.17
5	118 Cedar Street	.35	.28	.28	.20	.23	.10	.15	.29	.11	.08	.23	.20
6	555 LaForest St.	--	.29	.23	--	.25	.29	.25	.33	.13	.15	--	.21
7	Marion-McNaughton St.	--	.35	.27	.26	--	.12	--	.24	.12	.15	.17	.17
8	Kirkwood Dr.-Ramsey Lk. Rd.	.28	.21	.18	.10	--	.18	.13	.14	.10	--	.14	.17
9	1525 Southview Dr.	.36	.34	.21	.16	--	.21	.16	.30	.10	.08	--	.17
10	55 Tuddenham Ave.	.42	.30	.32	.15	--	.13	.19	.28	.10	.08	.29	.24
11	88 Second Avenue	.25	.31	.19	.13	--	.15	.13	.16	.08	--	.15	.13
12	51 Nickel Street*	.60	.95	.43	.26	.60	.40	.14	.26	.40	.48	--	--
13	3 Oliver Street*	.60	.26	.23	.55	.27	.24	.10	.10	.16	.13	.19	.39
	MEANS	.42	.38	.28	.29	.38	.20	.22	.33	.17	.21	.25	.24

* Copper Cliff Locations.

Table 7:

SUMMARY OF THE COEFFICIENT OF HAZE READINGS IN THE SUDBURY AREA FOR 1975 & 1974 (ALL VALUES IN COH UNITS/1000 LINEAR FT. OF AIR)

Station	Max. 1 Hr. Value		Max. 24 Hr. Avg.		Annual Avg.		Number of Times Above Criterion**			
							1974		1975	
	1974	1975	1974	1975	1974	1975	24 Hr.	1 Yr.	24 Hr.	1 Yr.
Ash Street	1.9 (Dec.)	2.9 (Jan.)	0.5 (Nov., Dec.)	0.6 (Nov., Dec.)	0.06	0.14	NIL	NIL	NIL	NIL
Coniston	1.1 (Oct., Dec.)	2.1 (Oct.)	0.4 (Dec.)	0.8 (Nov., Dec.)	0.13	0.15	NIL	NIL	NIL	NIL
19 Lisgar St.*	1.9 (Jan.)	2.2 (Oct.)	0.8 (Jan.)	0.8 (Dec.)	0.18	0.17	NIL	NIL	NIL	NIL

* 2 Hr. Readings

** 24 Hr. Criterion : 1.0 COH
1 Yr. Criterion : 0.5 COH

Table 8:

AVERAGE MONTHLY COEFFICIENT OF HAZE LEVELS IN THE SUDBURY AREA FOR 1975 & 1974 (ALL VALUES IN COH UNITS/1000 LINEAR FT. OF AIR)

Station	Year	Jan.	Feb.	March.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ash Street	1975	.26	.06	.15	.09	.13	.08	.08	.07	.15	.23	.19	.18
	1974	.07	.04	.02	.03	.03	.02	.05	.05	.03	.06	.15	.22
Coniston	1975	.19	.26	.19	.13	.13	.10	.14	.11	.08	.12	.22	.25
	1974	--	--	.19	--	.13	.13	.13	.12	.11	.12	.12	.16
19 Lisgar St.*	1975	.13	.10	.07	.07	.19	.19	.16	--	.20	.20	.26	.31
	1974	.30	.30	.22	--	--	.19	.15	.15	.14	.15	.16	.15

* 2 Hr. Readings.

Table 9:

ANNUAL HOURLY AVERAGE COH VALUES FOR THE STATIONS
IN THE SUDBURY AREA FOR 1975
(ALL VALUES IN COH UNITS/1000 LINEAR FEET OF AIR)

Location	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
Ash Street	.14	.13	.12	.12	.13	.16	.18	.18	.17	.15	.15	.14	.12	.11	.09	.10	.11	.13	.12	.12	.15	.15	.16	.17
Coniston	.15	.14	.14	.12	.14	.15	.20	.22	.23	.18	.17	.17	.12	.15	.17	.11	.14	.13	.12	.14	.13	.16	.14	.14
19 Lisgar Street*	---	.18	---	.15	---	.16	---	.20	---	.17	---	.17	---	.14	---	.15	---	.16	---	.14	---	.16	---	.16

* 2 Hr. Readings.

Table 10: SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT BURWASH FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
June 11	63	.55	.89	.02	.18	ND
17	46	.34	.48	.01	.12	ND
23	51	.43	.69	.01	.10	ND
29	43	.12	2.10	.01	.60	ND
July 5	36	.09	2.69	.01	0.93	ND
11	19	.26	2.97	.01	2.91	0.58
17	69	.09	1.07	ND		ND
23	34	.08	1.26	.04		ND
29	23	.14	1.50	.01		ND
August 4	16	.09	.61	.04		ND
10	26	.29	2.32	.02		ND
16	26	.04	.85	ND		ND
22	20	.14	1.97	ND		ND
28	16					
September 3	26					
9	10					
15	27					
21	12					
19	19					
October 3	21					
9	21					
15	9					

Table 11

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT MORGAN FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
May 30	24	.06	.72	.02	.05	ND
June 5	36	.13	1.18	.03	.10	.02
11	209	.36	9.67	.06	.09	.04
17	39	.26	1.07	.03	.12	.03
23	260	.37	11.96	.01	.09	ND
29	42	.52	1.50	ND	.03	.02
July 5	76	.59	2.20	ND	.01	ND
11	39	.86	1.27	.02	.02	.01
17	88	.65	1.83	.05		ND
23	29	.68	1.41	.04		.01
29	45	.55	1.25	.06		.03
August 4	26	.41	1.32	.05		.08
10	28	.51	.69	.04		ND
16	30	.80	1.15	.05		.02
22	17	.56	.84	ND		.04
28	33	.88	.99	ND		.06
September 3	22	.92	.94	.01		.02
9	7	.71	.44	.01		.07
15	24	.76	.63	ND		.02
21	11	.83	.35	.01		.04
27	39	.85	1.49	.01		.05
October 3	18	.38	.35	ND		.03
9	34	.46	.74	ND		.05
15	9	.52	.25	.01		.04
21	14	.45	.26	ND		.03

Table 12

SUMMARY OF THE HIGH VOLUME FILTER
MEASUREMENTS AT PENAGE FOR 1975
(ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
June 11	51	.07	.43	.01	.05	ND
17	38	.19	.45	ND	.08	ND
23	12	1.78	1.09	ND	.64	ND
29	41	1.27	1.87	ND	1.28	ND
July 5	51	.42	1.44	ND	.57	ND
11	23	.10	1.66	.01	.54	ND
17	96	.33	2.17	ND		.05
23	28	.24	2.24	.01		1.32
29	32	.22	2.31	ND		.22
August 4	18	.07	2.21	.03		.04
10	40	.05	3.06	ND		.04
16	61	.47	2.44	.01		4.30
22	22	.28	1.49	.02		3.65
28	13	.20	.31	ND		.01
September 3	13	.20	.42	ND		ND
9	6	.21	.02	ND		ND
15	25	.19	.30	ND		ND
21	11	.18	.30	ND		.01
27	11	.33	.03	ND		ND

Table 13

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT RAYSIDE FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
May 30	50	.85	1.60	.20	.15	.02
June 11	83	.49	1.74	.09	.16	.10
17	34	.68	.96	.11	.17	ND
23	76	1.04	1.26	.02	.07	.01
29	75	.33	4.67	.02	5.67	.10
July 5	62	.35	2.98	.01	3.09	.86
11	70	.67	3.51	.02	1.30	ND
17	129	.80	1.75	.01	1.29	ND
29	57	.64	1.29	.01		.08
August 4	39	.58	.71	ND		.05
10	75	1.13	1.73	.06		.02
16	91	.82	1.90	.03		ND
22	33	1.04	1.15	.02		.02
28	61	1.33	1.33	.01		.03
September 3	64	.93	2.24	.02		ND
9	29	1.04	.59	.03		.03
15	60	.96	1.17	.01		.06
21	16	1.45	.18	.01		.01
27	26	1.00	.69	.01		.01
October 3	36	1.55	.91	.01		.03
9	52	1.49	1.23	.02		.03

Table 14

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT SKEAD FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
June 17	37	.74	1.15	.14	.10	.08
23	79	.60	2.84	.18	.07	ND
29	63	.09	1.03	ND	.99	ND
July 5	48	.16	2.13	ND	1.02	ND
11	32	.07	2.34	.01	1.13	ND
17	81	.38	5.18	.03	ND	.55
23	37	.13	2.37	.02		ND
29	39	.40	1.04	.09		ND
August 4	28	.08	1.11	.11		ND
10	62	.05	1.11	.32		ND
16	38	.99	1.53	.09		.03
22	17	.43	.41			.01
28	26	.61	.75	ND		.01
September 3	28	.58	.78	.03		.01
9	13	.47	1.12	ND		ND
15	45	.44	1.64	.05		.05
21	14	.47	.19	.04		.03
28	15	.67	.66	.01		.06
October 3	24	.44	1.15	.06		.06
9	24	1.28	.80	.01		.06

Table 15

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT ST. CHARLES FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cu	Fe	Ni	Pb	Zn
June 17	47	.49	.49	.01	.07	ND
July 11	32	.08	1.59	ND	.67	ND
17	72	.42	2.61	.01	.55	ND
23	90	.77	3.01	.07		ND
29	24	.41	1.30	.08		ND
August 16	56	.25	1.83	.05		ND
22	46	.44	1.81	.02		.07
28	38	.45	1.69	.04		.05
September 3	24	.42	.91	.01		.05
9	30	.57	1.39	.01		.06
15	57	.18	1.18	.01		.06
21	11	.19	.38	ND		.04
27	68	.50	2.45	ND		.07
October 3	28	.19	.61	ND		.05
9	37	.42	1.38	ND		.05
15	9	.27	.21	.01		.07
21	21	.22	.43	ND		.04
27	23	.08	.50	ND		.06

Table 16

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS FOR ASH ST. FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	As	Cu	Fe	Ni	Pb	Mn	V
January 6	22	.003	.13	.66	ND	.5		
12	41	.010	.48	3.11	.3	.1		
18	30	.019	.72	.81	.2	.4		
24	23	.003	.10	.77	.02	.9		
30	30	.008	.27	1.04	.52	.7		
February 5	22	.016	.25	1.12	.19	.7		
11	21	.076	.11	.61	.10	.8		
23	21	.021	.17	1.01	.13	.4		
26	26	.017	.15		.17	.7		
March 1	14	.004	.10	.61	.13	.2		
7	47		.65	1.94	1.52	.3		
13	27	.006	.20	1.20	.56	.8		
19	43	.005	.14	1.37	.18	.6		
25	14	.004	.04	.72	.03	.2		
31	22	.009	.35	1.35	.37	.2		
April 6	26	.002	.10	1.56	.07	ND		
12	21	.001	.08	2.94	.07	ND		
18	54					.6	.02	ND
24	25					.1	.01	ND
30	85					.4	.04	.01
May 6	45					.4	.02	.02
12	50					.3	.02	.01
24	55					.4	.03	ND
30	51					.5	.03	.01
June 5	32	.007	.37	1.6	.11	.6		
11	80	.003	.28	2.3	.08	.6		
17	48	.002	.22	1.2	.03	.6		
23	92	.014	.70	4.7	.61	.3		
29	35	.027	.34	2.0	.18	.3		
July 5	56	.013	.62	3.2	.61	.3		
11	31	.003	.11	2.4	.04	.2		
29	42	.007	.43	1.9	.51	.3		
August 4	46	.015	.69	3.1	.45	.2		
10	47	.030	1.1	3.2	.31	.2		
16	65	.030	.98	3.2	.60	.5		
22	29	.002	.31	1.3	.05	.3		
28	87	.013	.82	3.5	.42	.2		
September 3	14	.002	.21	.8	ND	.3		
9	20	.017	.14	1.1	.32	.2		
15	47	.004	.18	1.8	.10	.1		
21	25	.020	.06	1.4	.44	.2		
27	32	.002	1.5	1.2	.07	.4		
October 3	52		1.3		.56	.3		
9	51		1.0	1.7	.06	.5		
15	18		.5	.5	.15	.3		
21	39		2.0	1.7	.75	.5		
27	32		.35	.8	.09	.3		
November 2	34		.39	.7	.25	.8		
8	27		1.11	1.4	.47	.3		

Table 16
Con't.

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS FOR ASH ST. FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date		Total Suspended Particulate Filter	As	Cu	Fe	Ni	Pb	Mn	V
November	14	28		.72	.9	.19	.5		
	20	25		.40	2.0	.14	.2		
	26	18		.44	.7	.09	.3		
December	2	6		.31	.7	.02	.1		
	8	57		.28	2.4	.08	.6		
	14	25		.39	1.3	.17	.6		
	21	20		.25	1.5	.14	.4		
	26	21		.30	1.0	.05	ND		

Table 17

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT CONISTON FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	As	Cu	Fe	Ni	Pb
February 18	19	.012	.21	.44	.03	.27
19	23	.021	.41	.84	.07	.43
20	24	.003	.21	.77	.05	.17
21	32	.006	.25	1.42	.06	.37
24	26	.006	7.32	.54	.03	.16
25	13	.002	.15	.39	.02	.08
26	20	.010	.55	1.05	.40	.23
27	15	.005	.28	.52	.08	.19
28	16	.002	.28	.73	.02	.12
March 3	19	ND	.09	.70	.01	.17
4	42	.005	.35	1.28	.17	.43
5	32	.007	.31	1.24	.16	.38
6	33	.009	.37	.57	.11	.41
7	35	.016	.30	1.28	.25	.35
8	55	.004	.18	3.50	.03	.35
11	46	.016	.34	3.12	.13	.42
12	21	.003	.13	.67	.03	.15
13	38	.005	.23	1.26	.16	.57
14	73	.021	.27	2.89	.11	1.07
15	65	.036	.40	3.50	.12	1.08
18	45	.004	.12	1.89	.03	.49
10	36	.010	.20	.98	.04	.48
20	41	.034	.20	2.13	.17	.16
21	24	.004	.14	1.41	.04	.16
22	20	.004	.13	1.25	.05	.17
25	8	.058	.17	1.44	.19	.14
26	14	.003	.09	.63	.03	.11
27	74	.109	.37	3.00	.25	.53
28	51	.008	.29	1.85	.08	.36
April 2	48	.041	.19	3.40	.12	.24
3	71	.034	.18	3.55	.14	.19
6	30	.002	.10	1.66	.02	.07
5	32	.002	.04	1.42	.04	.08
8	26	.002	.04	1.03	.03	.09
9	34	.009	.14	1.37	.06	.13
10	43	.014	.16	1.84	.11	.18
11	46	.003	.09	2.10	.03	.14
12	44	.010	.12	2.22	.06	.21
15	67	.006	.20	3.26	.13	.24
16	79	.011	.13	2.74	.42	.42
17	59	.014	.20	3.59	.13	.23
20	33	.001	.04	1.69	.01	.11
26	59	.003	.09	2.98	.08	.36
May 2	61	.024	.26	3.53	.22	.28
12	39	.031	.18	2.19	.16	.16
18	76	.005	.11	2.41	.06	.25
24	66	.009	.10	2.09	.03	.16
30	47	.004	.13	1.51	.04	.10

Table 17
(Con't)

SUMMARY OF THE HIGH VOLUME FILTER
MEASUREMENTS AT CONISTON FOR 1975
(ALL VALUES IN MICROGRAMS/METRE^3)

Date	Total Suspended Particulate Matter	As	Cu	Fe	Ni	Pb
June 5	33	.007	.18	1.23	.07	.13
11	56	.004	.30	2.93	.12	.14
17	33	.002	.07	1.17	.04	.12
23	108	.005	.19	4.22	.11	.32
29	40	.012	.12	1.98	.05	.14
July 5	70	.022	.34	3.90	.04	.25
11	41	.023	.32	3.98	.25	.16
17	117	.003	.18	4.17	.10	.17
23	65	.020	.49	3.56	.21	
29	48	.003	.19	2.83	.08	
August 4	39	.007	.33	2.07	.07	
10	56	.007	.28	4.27	.17	
16	54	.004	.27	3.40	.11	
22	28	.002	.10	1.44	.02	.15
28	68	.017	.40	4.15	.31	.30
September 3	42	.011	.15	2.03	.03	.18
9	33	.001	.29	1.73	.02	.25
15	71	.001	.24	2.40	.04	.13
21	23	.001	.25	1.66	.02	.14
27	29	.002	.32	3.35	.02	.24
October 3	40		.12	1.76	.04	.15
9	35		.30	1.33	.01	.15
15	14		.24	.79	ND	.12
21	40		.21	1.45	.03	.24
27	35		.30	1.28	.01	.13
November 2	35		.45	1.46	.01	.66
8	29		.20	1.49	.04	.23
14	42		.17	1.5	.05	.2
20	14		.26	.5	.03	.1
26	26		.35	1.0	.05	.2
December 2	21		.72	.9	.11	.6
8	40		.50	1.3	.03	.3
14	22		.31	.3	.02	.2
20	24		.23	.6	.05	.2
26	22		.29	.4	.04	.1

Table 18

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENTS AT LISGAR STREET FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cd	Pb	Mn	V
January 6	28		.98		
12	68		.40		
18	46		.95		
24	41		1.97		
30	38		1.14		
February					
11	29		1.16		
17	38		1.13		
23	31		.84		
March 1	18		.36		
7	64		1.02		
13	50		1.52		
19	50		1.10		
25	21		.45		
31	50		.47		
April 6	26		.24		
12	89		.81		
18	68	.003	.90	.024	.042
24	66	ND	.67	.019	.009
30	95	ND	.53	.035	.020
May 6	94	.002	1.11	.038	.021
12	117	.004	.75	.052	.029
18	89	ND	.32	.034	.018
24	71	.002	.52	.034	.008
30	34	.002	.33	.022	ND
June 5	37		.60		
11	82		.59		
17	62		.62		
23	91		.25		
29	56		.65		
July 5	72		.38		
11	52		.65		
17	115		.33		
23	45		.42		
August 10	61		.30		
16	84		.90		
22	68		1.70		
28	69		.65		
September 3	50		.67		
9	45		.47		
15	67				
21	32		.28		
27	58		1.67		
October 3	67		.69		
9	65		1.02		
15	36		.85		
21	61		.85		
November 2	37		1.25		

Table 18
Con't.

SUMMARY OF THE HIGH VOLUME FILTER MEASUREMENT AT LISGAR STREET FOR 1975 (ALL VALUES IN MICROGRAMS/METER^3)

Date	Total Suspended Particulate Matter	Cd	Pb	Mn	V
November 8	34		.4		
14	39		.7		
20	30		.5		
26	23		.9		
December 2	29		1.1		
8	38		.7		
14	29		.4		
20	28		1.0		
26	24		.4		

Table 19

SUMMARY OF THE HIGH VOLUME FILTER ANALYSIS BY ATOMIC ABSORPTION FOR STATIONS IN THE SUDBURY DISTRICT FOR 1975 AND 1974

Station	Element	No. of Samples Analyzed		Max. 24 Hr. Value (ug/m^3)		OME Criterion For 24 Hr. (ug/m^3)	No. of Times Above Criterion	
		1975	1974	1975	1974		1975	1974
Burwash	Cu	13	25	.55	.68	50	NIL	NIL
	Fe	13	25	2.97	2.60	No Criterion	---	---
	Ni	16	25	.04	.13	2	NIL	NIL
	Pb	6	NIL	2.91	---	5	NIL	---
	Zn	13	25	.58	.10	No Criterion	---	---
Morgan	Cu	25	28	.92	1.85	50	NIL	NIL
	Fe	25	28	11.96	8.60	No Criterion	---	---
	Ni	25	28	.06	.09	2	NIL	NIL
	Pb	8	NIL	.12	---	5	NIL	---
	Zn	25	28	.08	.10	No Criterion	---	---
Penage	Cu	19	29	1.78	.30	50	NIL	NIL
	Fe	19	29	3.06	.70	No Criterion	---	---
	Ni	13	29	.03	.09	2	NIL	NIL
	Pb	6	NIL	1.28	---	5	NIL	---
	Zn	19	29	4.30	.10	No Criterion	---	---
Rayside	Cu	21	24	1.55	.39	50	NIL	NIL
	Fe	21	24	4.67	3.60	No Criterion	---	---
	Ni	21	24	.20	.37	2	NIL	NIL
	Pb	8	NIL	5.67	---	5	1	---
	Zn	21	24	.86	5.00	No Criterion	---	---
Skead	Cu	20	23	1.28	.60	50	NIL	NIL
	Fe	20	23	5.18	5.50	No Criterion	---	---
	Ni	19	24	.32	.62	2	NIL	NIL
	Pb	6	NIL	1.13	---	5	NIL	---
	Zn	20	24	.55	1.00	No Criterion	---	---
St. Charles	Cu	18	27	.77	9.21	50	NIL	NIL
	Fe	18	27	3.01	3.00	No Criterion	---	---
	Ni	18	27	.08	.06	2	NIL	NIL
	Pb	3	NIL	.67	---	5	NIL	---
	Zn	18	27	.07	.10	No Criterion	---	---

TABLE 20 TOTAL DUSTFALL LEVELS IN THE SUDBURY DISTRICT FOR 1975 EXPRESSED IN TONS/SQ. MILE/30 DAYS

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
PENAGE	9	11	9	4	3	20
BURWASH	5	7	6	3	3	3
SKEAD	9	22	11	6	4	7
RAYSIDE	8	10	14	20	14	9
MORGAN	68	18	10	3	--	27
ST. CHARLES	12	50	62	31	16	16
GRASSY LAKE	6	9	10	5	--	9
CHINIGUCHI LAKE	--	--	7	4	2	4

TABLE 21

PERCENT SOLUBLE $SO_4^=$ IN TOTAL DUSTFALL IN THE SUDBURY DISTRICT FOR 1975

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.
PENAGE	9	16	14	15	40	7
BURWASH	17	22	13	13	41	39
SKEAD	15	9	22	12	34	23
RAYSIDE	17	12	6	4	8	13
MORGAN	5	9	12	10	--	6
ST. CHARLES	8	6	3	4	10	9
GRASSY LAKE	3	26	17	7	--	8
CHINIGUCHI LAKE	--	--	13	19	59	26

TABLE 22

TOTAL SOLUBLE SULPHATE LOADING IN DUSTFALL JARS IN THE SUDBURY DISTRICT DURING 1975 (TONS/SQ. MILE/30 DAYS).

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	MEAN
PENAGE	0.8	1.8	1.3	0.6	1.2	1.4	1.2
BURWASH	0.8	1.5	0.8	0.4	1.2	1.2	1.0
SKEAD	1.3	2.0	2.4	0.7	1.4	1.6	1.6
RAYSIDE	1.4	1.2	0.8	0.8	1.1	1.2	1.1
MORGAN	3.4	0.8	1.2	0.3	---	1.6	1.5
ST. CHARLES	0.9	3.0	1.9	1.2	1.6	1.4	1.7
GRASSY LAKE	0.2	0.2	1.7	0.3	---	0.7	1.0
CHINIGUCHI LAKE	---	---	0.9	0.8	1.2	1.0	1.0

TABLE 23

PERCENT COPPER IN TOTAL DUSTFALL IN THE SUDBURY DISTRICT FOR 1975

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	MEAN
PENAGE	.08	.02	.02	.07	.22	.50	.15
BURWASH	.16	.05	.15	.14	.23	.43	.19
SKEAD	.49	.15	.77	.34	.26	.17	.36
RAYSIDE	.38	.13	.04	.04	.08	.19	.14
MORGAN	.02	.11	.19	.09	---	.04	.09
ST. CHARLES	.05	.03	.04	.02	.05	.04	.04
GRASSY LAKE	.05	.11	.14	.10	---	.11	.10
CHINIGUCHI LAKE	---	---	.16	.10	.60	.20	.26

TABLE 24

PERCENT IRON IN TOTAL DUSTFALL IN THE SUDBURY DISTRICT FOR 1975

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	MEAN
PENAGE	1.2	0.6	.08	2.7	2.0	3.5	1.8
BURWASH	1.5	4.9	1.4	4.4	3.9	4.1	3.4
SKEAD	4.5	11.9	4.7	5.5	3.4	1.9	5.3
RAYSIDE	2.7	2.3	1.6	1.6	1.9	2.3	2.1
MORGAN	0.8	2.6	1.7	2.2	---	4.1	2.3
ST. CHARLES	1.6	1.2	1.0	1.9	1.7	1.5	1.5
GRASSY LAKE	2.7	1.4	1.7	3.6	---	1.7	2.2
CHINIGUCHI LAKE	---	---	1.4	2.7	3.9	1.8	2.4

TABLE 25 PERCENT NICKEL IN TOTAL DUSTFALL IN THE SUDBURY DISTRICT FOR 1975

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	MEAN
PENAGE	.02	.01	.01	.04	.04	.32	.07
BURWASH	.05	.03	.04	.10	.40	.21	.14
SKEAD	.41	.14	.50	.24	.38	.14	.30
RAYSIDE	.15	.07	.02	.03	.11	.20	.09
MORGAN	.01	.01	.06	.06	---	.03	.03
ST. CHARLES	.04	.01	.03	.02	.11	.03	.04
GRASSY LAKE	.04	.04	.06	.08	---	.07	.06
CHINIGUCHI LAKE	---	---	.14	.04	.07	.12	.09

TABLE 26

PERCENT ZINC IN TOTAL DUSTFALL IN THE SUDBURY DISTRICT FOR 1975

LOCATION	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	MEAN
PENAGE	.03	.02	.03	.11	.37	.37	.15
BURWASH	.04	.04	.70	.12	.45	.81	.36
SKEAD	.04	.64	.42	.08	.46	.40	.34
RAYSIDE	.04	.04	.06	.02	.06	.17	.06
MORGAN	.05	.03	.03	.11	---	.55	.15
ST. CHARLES	.04	.03	.04	.04	.08	.08	.05
GRASSY LAKE	.05	.03	.02	.09	---	.36	.11
CHINIGUCHI LAKE	---	---	.20	.09	.07	.69	.26

Table 27:

TOTAL DUSTFALL LEVELS IN THE CITY OF SUDBURY FOR 1975 (TONS/SQ.MILE/30 DAYS)

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Ash Street	4	5	6	--	13	9	13	9	7	7	6	6
2	Lisgar Street	5	6	8	16	20	10	12	8	8	9	6	5
3	Auger Avenue	7	7	8	11	19	13	15	8	11	11	8	5
4	William Street	3	3	7	8	18	10	13	11	8	10	5	4
5	Cedar Street	12	11	18	34	33	24	25	19	18	6	14	-
6	Laforest Avenue	7	--	7	15	18	17	19	14	8	--	--	-
7	Marion-McNaughton Sts.	6	5	7	12	16	12	15	7	8	11	16	4
8	Kirkwood Dr.-Ramsey Lk.Rd.	4	4	4	8	14	11	12	4	3	7	6	12
9	Southview Drive	4	6	7	6	18	6	11	6	8	7	5	4
10	Tuddenham Avenue	12	9	6	11	23	11	25	14	9	17	18	7
11	Second Avenue	4	13	12	14	22	26	26	28	22	14	13	5
13	Oliver Street	80	10	10	16	23	40	40	12	11	13	15	10
14	Penman Avenue	14	14	7	11	--	23	23	31	9	8	14	5
15	Hwy. 17 West	--	--	--	87	35	24	15	18	27	16	81	62
	MEAN	12	8	8	19	21	16	19	13	11	10	16	11

Table 28

ANNUAL MEAN DUSTFALL LEVELS AND THE NUMBER OF TIMES ABOVE THE CRITERIA FOR LOCATIONS IN THE CITY OF SUDBURY FROM 1973 -1975

	Annual Mean (tons/sq.mile/30 days)			Number of Times Above Ontario Criteria					
				1975		1974		1973	
Location	1975	1974	1973	30 days	1 Yr.	30 Days	1 Yr.	30 days	1 Yr.
Ash Street	8"	10	11"	NIL	NIL	NIL	NIL	1	NIL
Lisgar St.	9	13	11	NIL	NIL	1	NIL	1	NIL
Auger Ave.	10	14"	11	NIL	NIL	1	1	NIL	NIL
William St.	8	9	10	NIL	NIL	NIL	NIL	NIL	NIL
Cedar St.	19"	23	23	4	1	8	1	8	1
Laforest Ave.	13^{8}	15	17^{7}	NIL	NIL	3	1	2	1
Marion-McNaughton	9	13	11	NIL	NIL	1	NIL	1	NIL
Kirkwood-Ramsey Lk.Rd.	7	10	8	NIL	NIL	NIL	NIL	NIL	NIL
Southview Drive	7	8	9	NIL	NIL	NIL	NIL	NIL	NIL
Tuddenham Avenue	15	14	15	3	1	1	1	3	1
Second Avenue	17	18	13"	5	1	2	1	NIL	NIL
Oliver Street	23	17	19"	4	1	2	1	6	1
Penman Avenue	14"	10^{4}	---	3	1	NIL	NIL	---	---
Hwy. 17 West	40^{9}		---	6	1	---	---	---	---
			TOTAL	25	6	19	6	22	4

Table 29

PERCENT SOLUBLE $SO_4^=$ IN TOTAL DUSTFALL IN THE CITY OF SUDBURY FOR 1975

Site No.	Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	Ash Street	24	16	14	--	15	18	19	8	28	30	31	11
2	Lisgar Street	15	18	12	8	6	15	12	9	21	16	27	11
3	Auger Avenue	9	13	14	16	9	11	11	12	16	17	19	9
4	William Street	20	19	10	18	8	14	14	8	20	15	23	10
5	Cedar Street	6	10	6	5	5	7	7	4	9	28	11	--
6	Laforest Avenue	22	2	16	15	13	14	18	10	29	1	--	--
7	Marion-McNaughton Sts.	23	25	13	15	14	16	12	15	30	16	23	20
8	Kirkwood Dr.-Ramsey Lk.Rd.	14	19	14	14	10	14	13	15	29	15	16	3
9	Southview Drive	18	15	13	19	11	23	13	11	24	22	25	12
10	Tuddenham Avenue	9	15	14	15	12	18	10	8	22	15	15	18
11	Second Avenue	18	15	6	8	6	5	7	10	5	11	13	9
13	Oliver Street	3	22	11	16	10	12	6	7	19	20	21	13
14	Penman Avenue	4	12	8	3	--	7	9	4	16	15	10	7
15	Hwy. 17 West	--	--	--	--	10	11	9	4	9	9	17	1

Table 30

FLUORIDATION RATES IN MICROGRAMS F/100 CM^2/30 DAYS ON LIME CANDLES DURING 1975 IN THE CITY OF SUDBURY

Candle Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Ash Street	2	1	5	6	2	--	24	54	15	5	4	4
Lisgar Street	6	3	7	7	5	--	20	42	15	7	7	6

Table 30

MEAN FLUORIDATION RATES IN MICROGRAMS F/100 CM^2/30 DAYS IN THE CITY OF SUDBURY FROM 1970 TO 1975

Candle Location	ANNUAL MEAN FLUORIDATION RATES					
	1970	1971	1972	1973	1974	1975
Ash Street	16^{11}	40^{6}	19^{8}	25	12^{11}	11^{11}
Lisgar Street	---	---	14^{6}	25	16^{8}	11^{11}

Table 31

AVERAGE MONTHLY FLUORIDATION RATES IN MICROGRAMS F/100 CM^2/30 DAYS AT ASH STREET FROM 1970 TO 1975

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5^{4}	25^{5}	16^{5}	19	27	12^{4}	23^{5}	29	14^{4}	10^{5}	25^{4}	16^{5}

Table 32

AVERAGE MONTHLY FLUORIDATION RATES IN MICROGRAMS F/100 CM^2/30DAYS AT LISGAR STREET FROM 1972 TO 1975

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
10^{3}	20^{3}	14^{3}	11^{3}	16	4^{2}	33	36	17^{2}	7^{3}	8^{3}	11^{3}

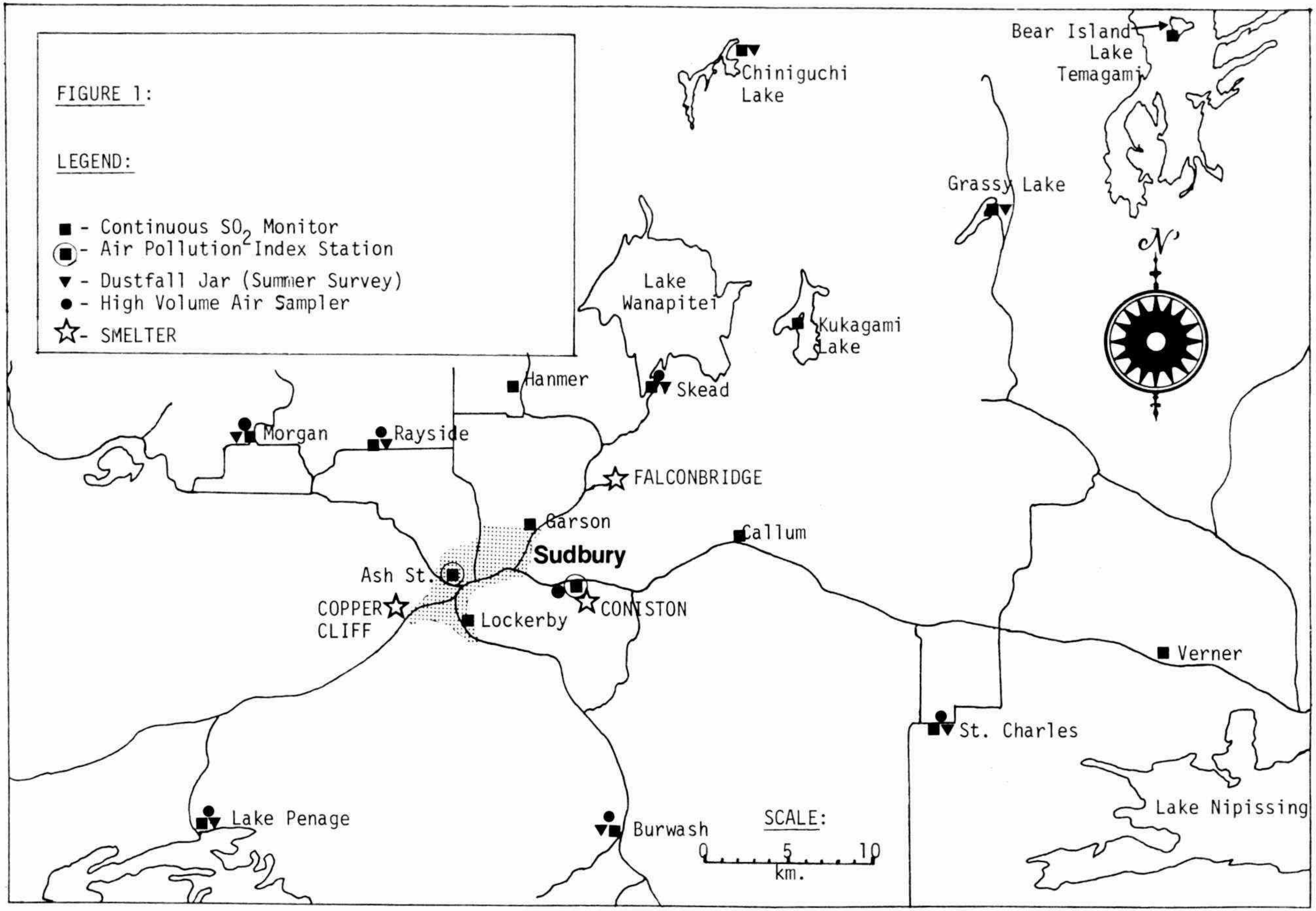


FIGURE 1:

LEGEND:
■ - Continuous SO2 Monitor
▣ - Air Pollution Index Station
▼ - Dustfall Jar (Summer Survey)
● - High Volume Air Sampler
☆ - SMELTER
Chiniguchi Lake
Bear Island
Lake Temagami
Grassy Lake
Lake Wanapitei
Kukagami Lake
Hanmer
Skead
Morgan
Rayside
FALCONBRIDGE
Garson
Callum
Sudbury
Ash St.
COPPER CLIFF
Lockerby
CONISTON
Verner
St. Charles
Lake Nipissing
Lake Penage
Burwash
SCALE:
0
5
10
km.
N

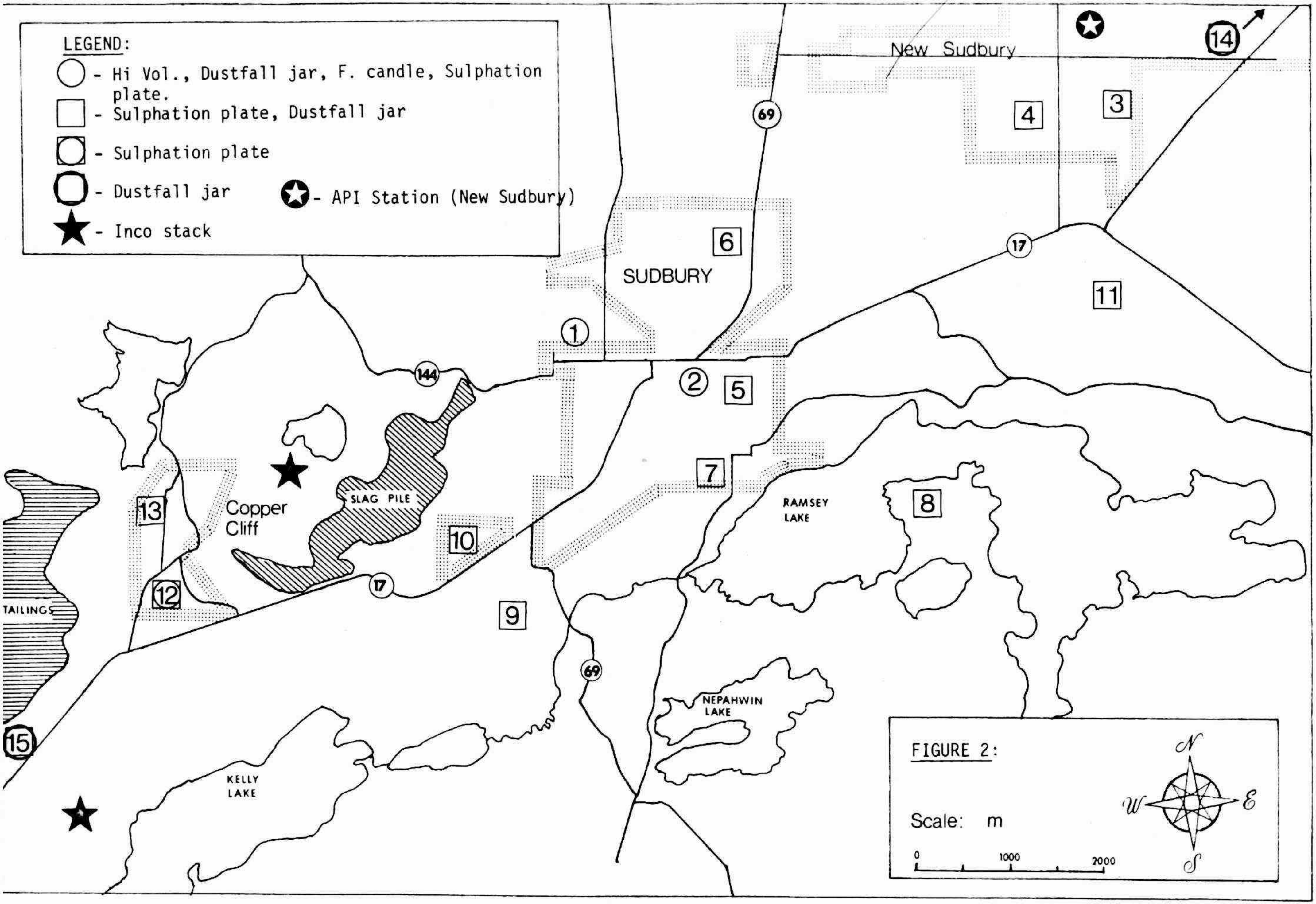


FIGURE 2:

LEGEND:
○ - Hi Vol., Dustfall jar, F. candle, Sulphation plate.
□ - Sulphation plate, Dustfall jar
- Sulphation plate
- Dustfall jar
- API Station (New Sudbury)
★ - Inco stack
New Sudbury
SUDBURY
Copper Cliff
SLAG PILE
TAILINGS
RAMSEY LAKE
NEPAHWIN LAKE
KELLY LAKE
69
17
144
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Scale: m
0
1000
2000
N
E
S
W

FIGURE 3

MONTHLY AVERAGE SULPHATION RATES IN THE CITY OF SUDBURY DURING 1975

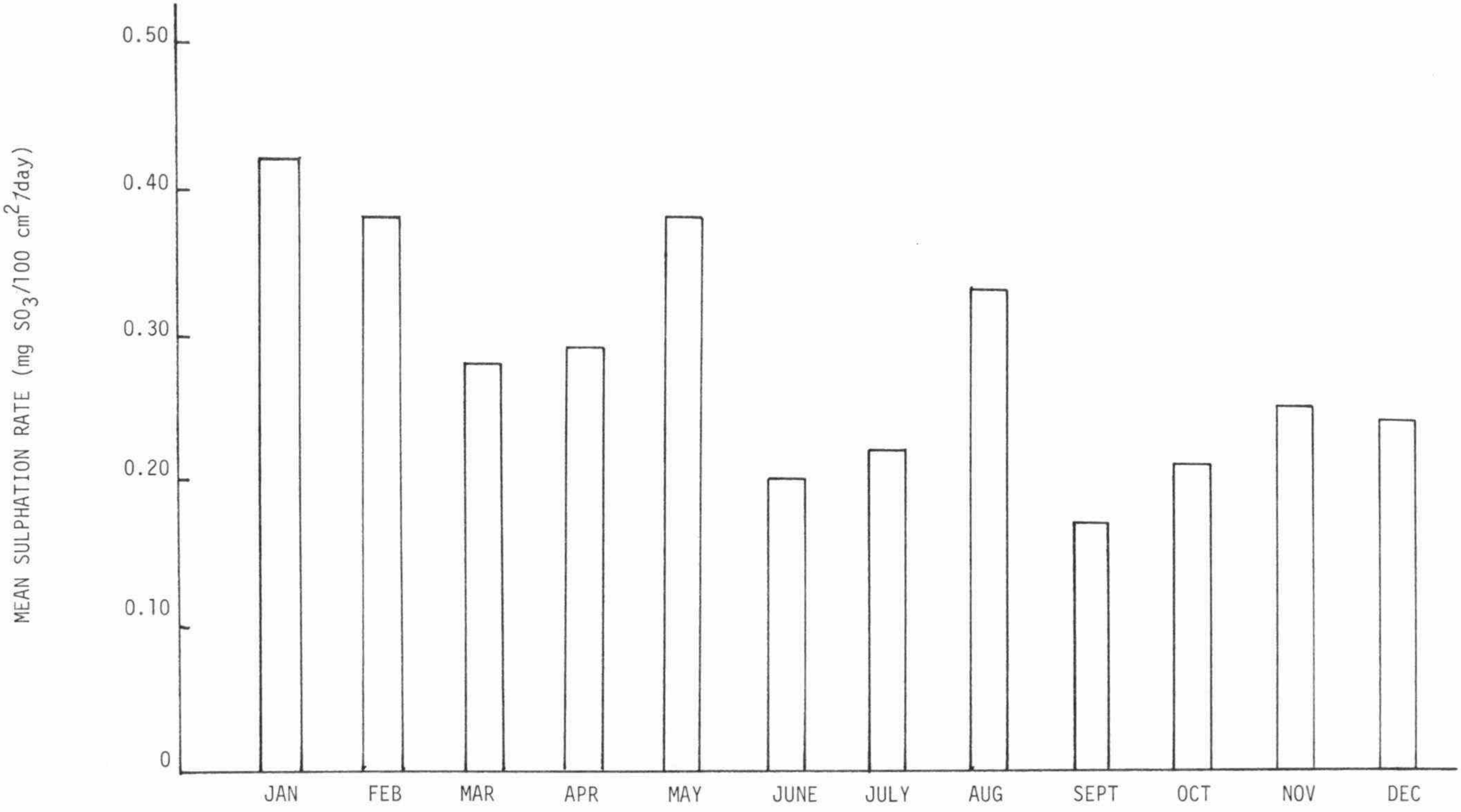


FIGURE 4

AVERAGE MONTHLY LEVELS OF COEFFICIENT OF HAZE AT ASH STREET (1 HR. READINGS)

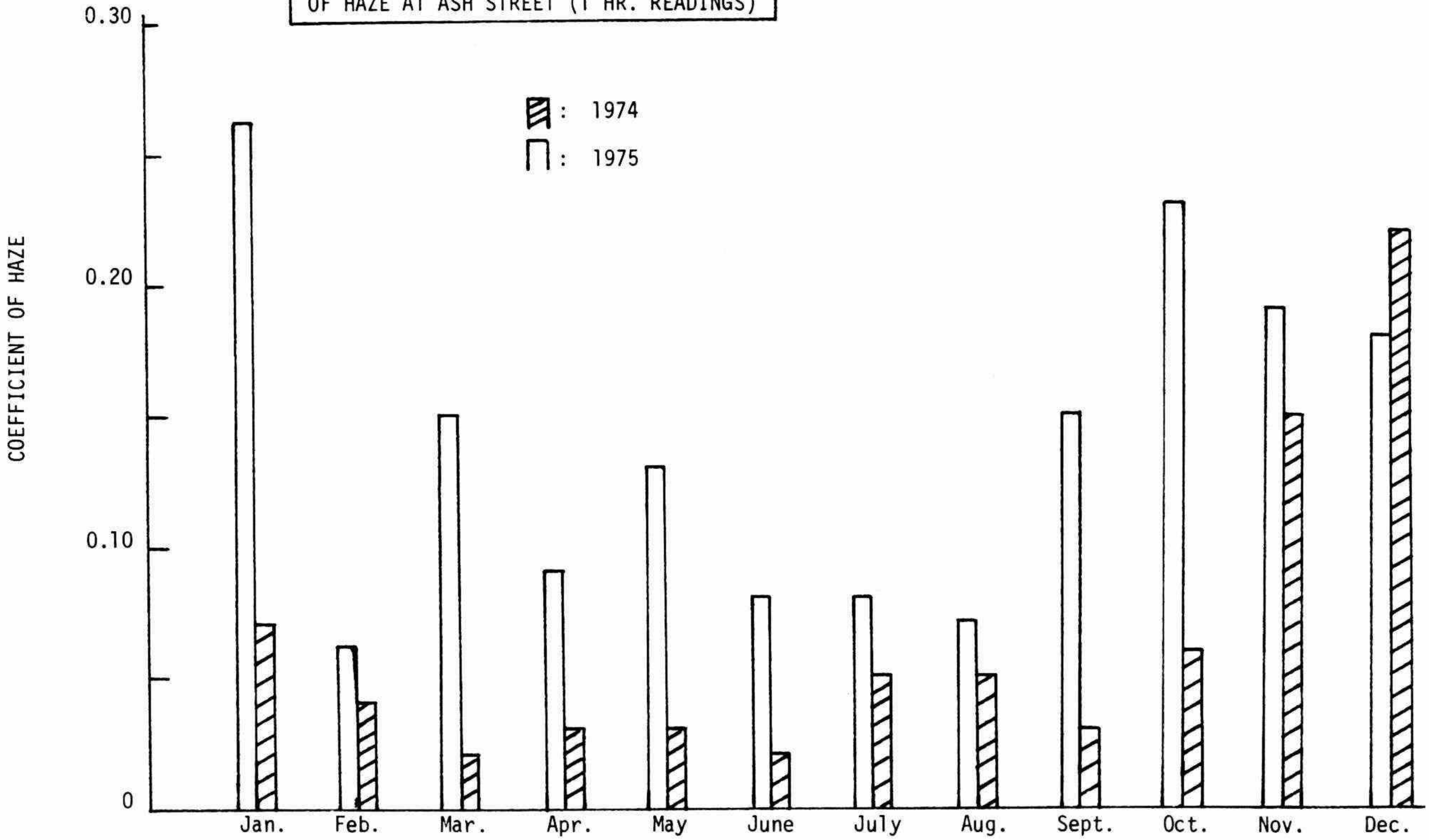


FIGURE 5

AVERAGE MONTHLY LEVELS OF COEFFICIENT OF HAZE AT CONISTON (1 hr. READINGS)

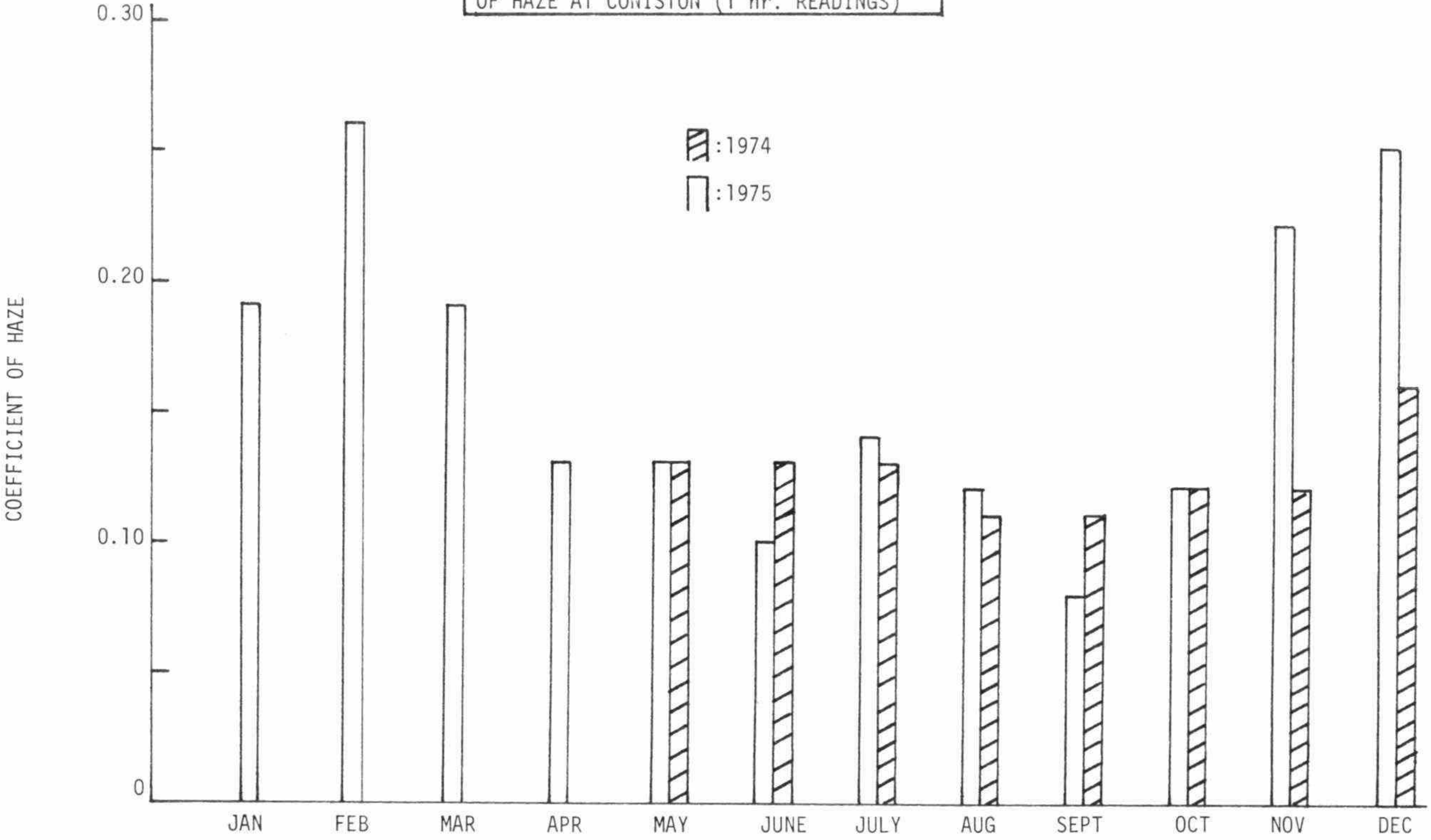
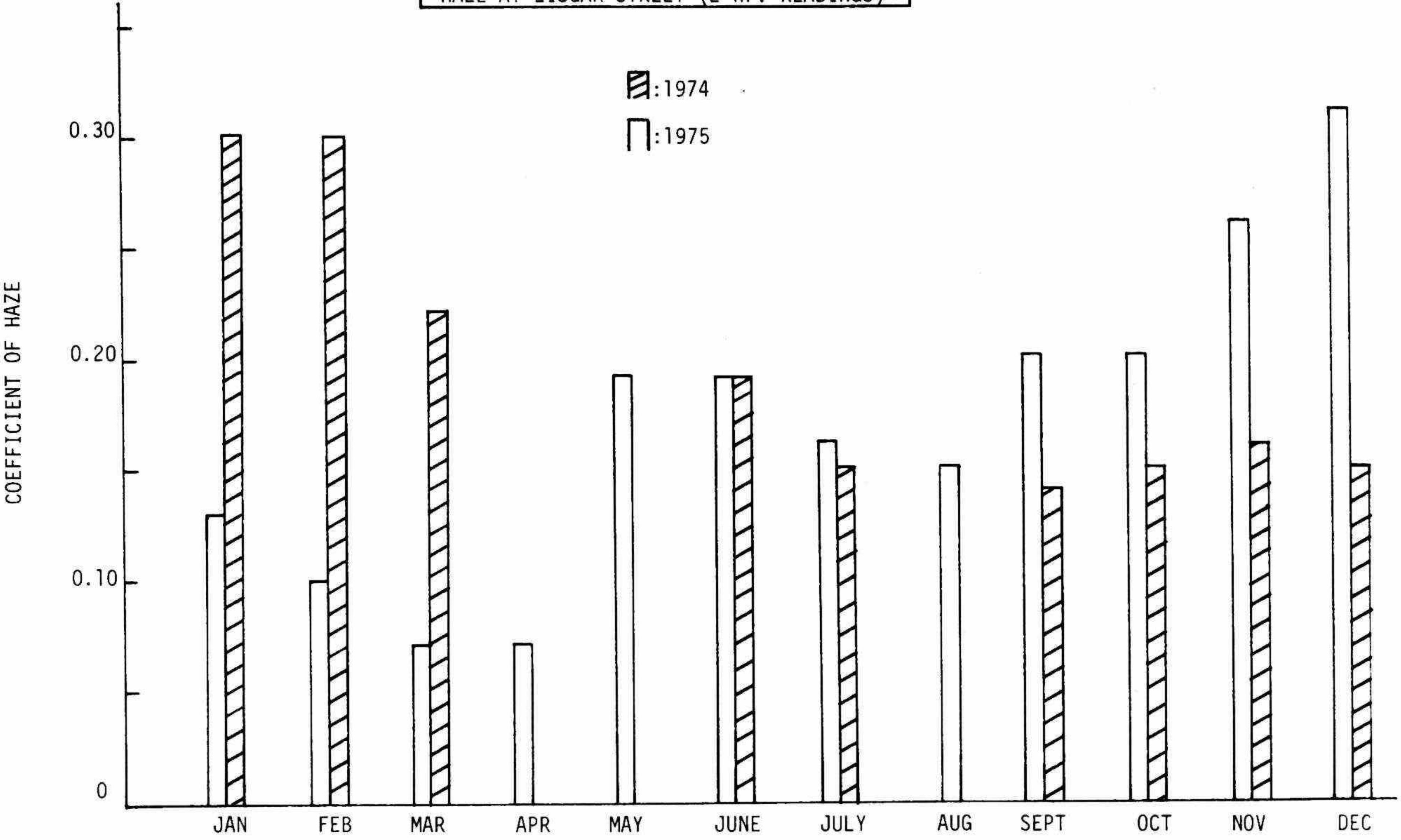


FIGURE 6
AVERAGE MONTHLY LEVELS OF COEFFICIENT OF HAZE AT LISGAR STREET (2 hr. READINGS)



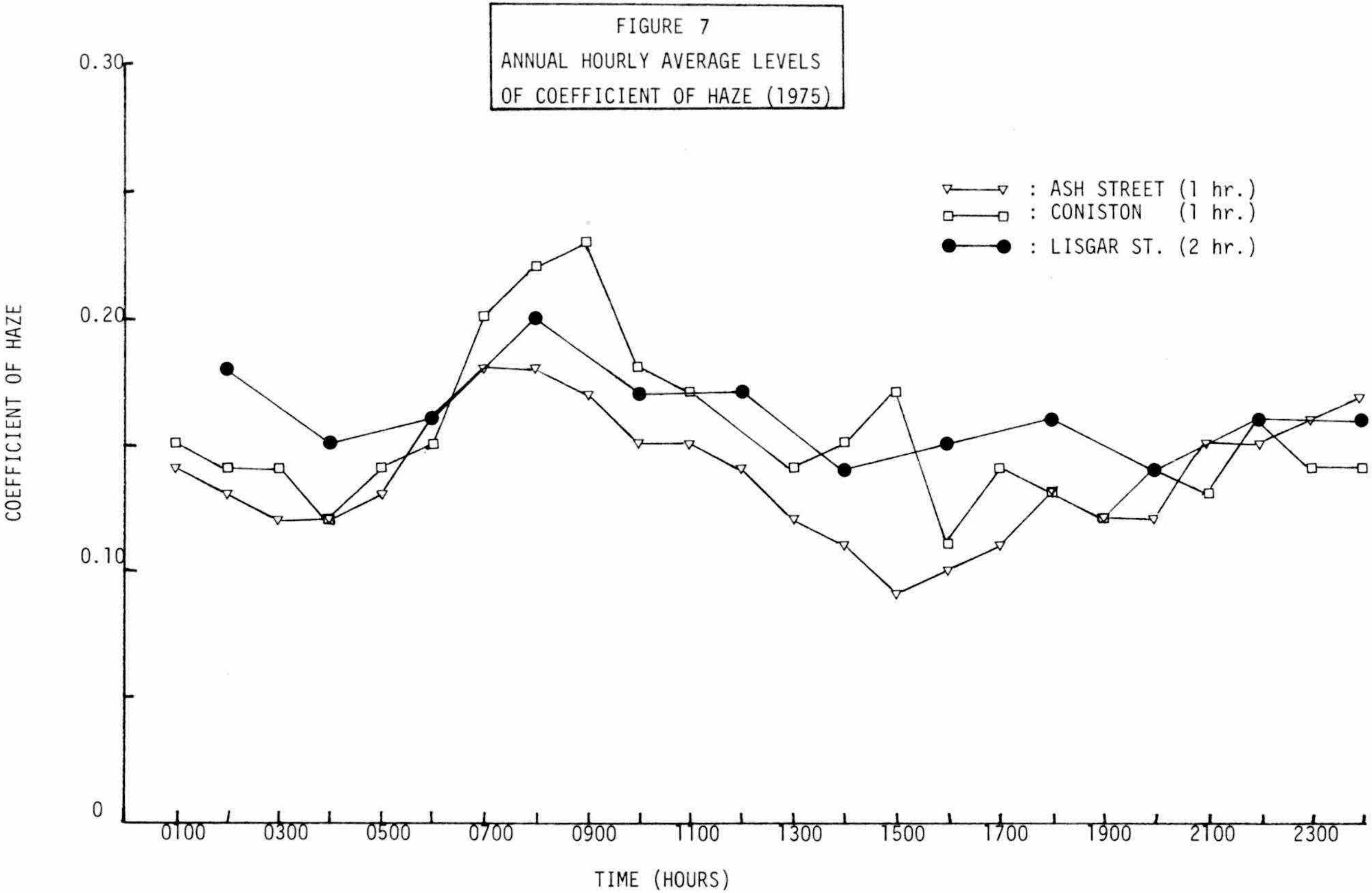
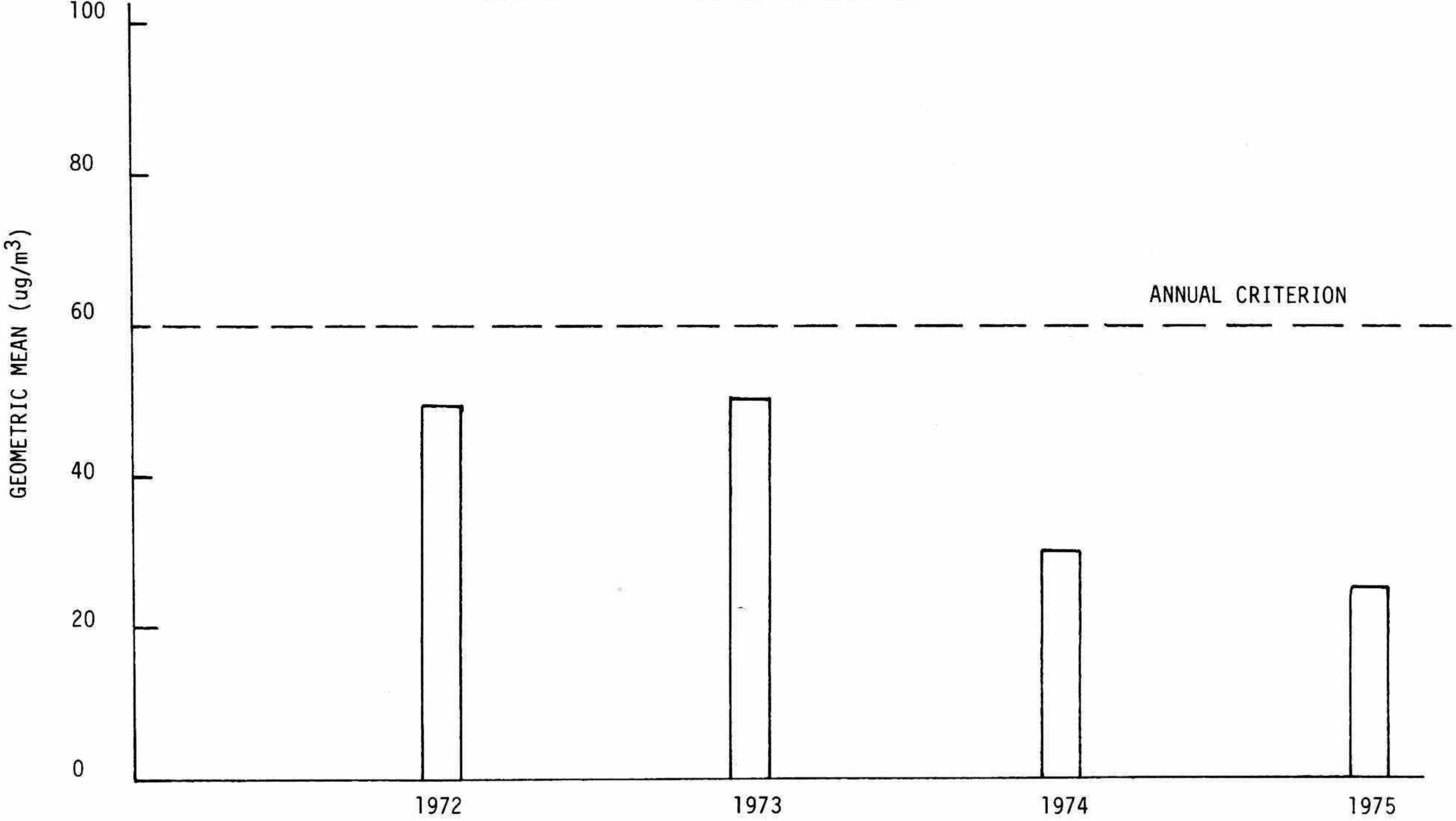


FIGURE 7
ANNUAL HOURLY AVERAGE LEVELS
OF COEFFICIENT OF HAZE (1975)

FIGURE 8
ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT BURWASH



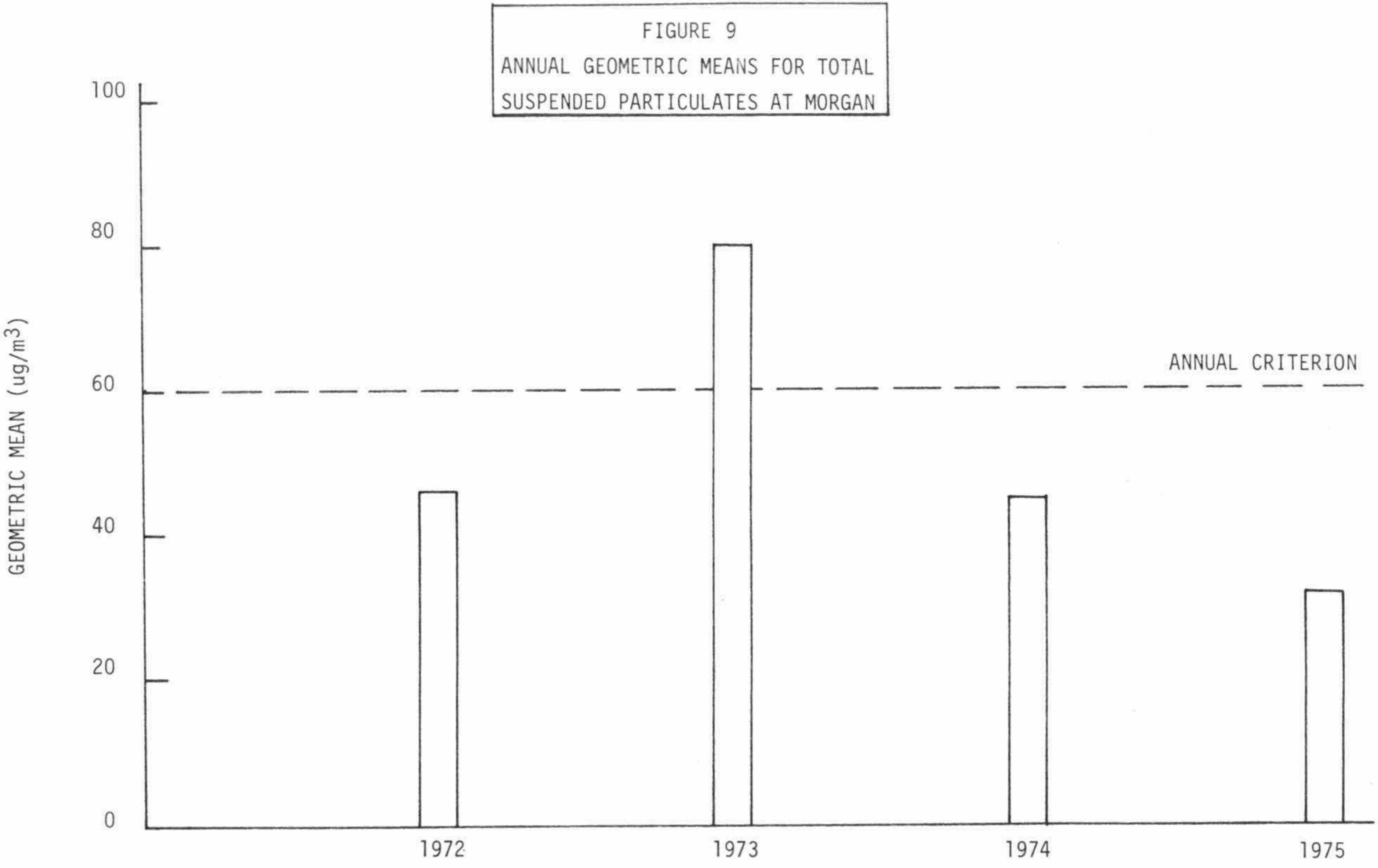


FIGURE 9
ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT MORGAN

FIGURE 10
ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT PENAGE

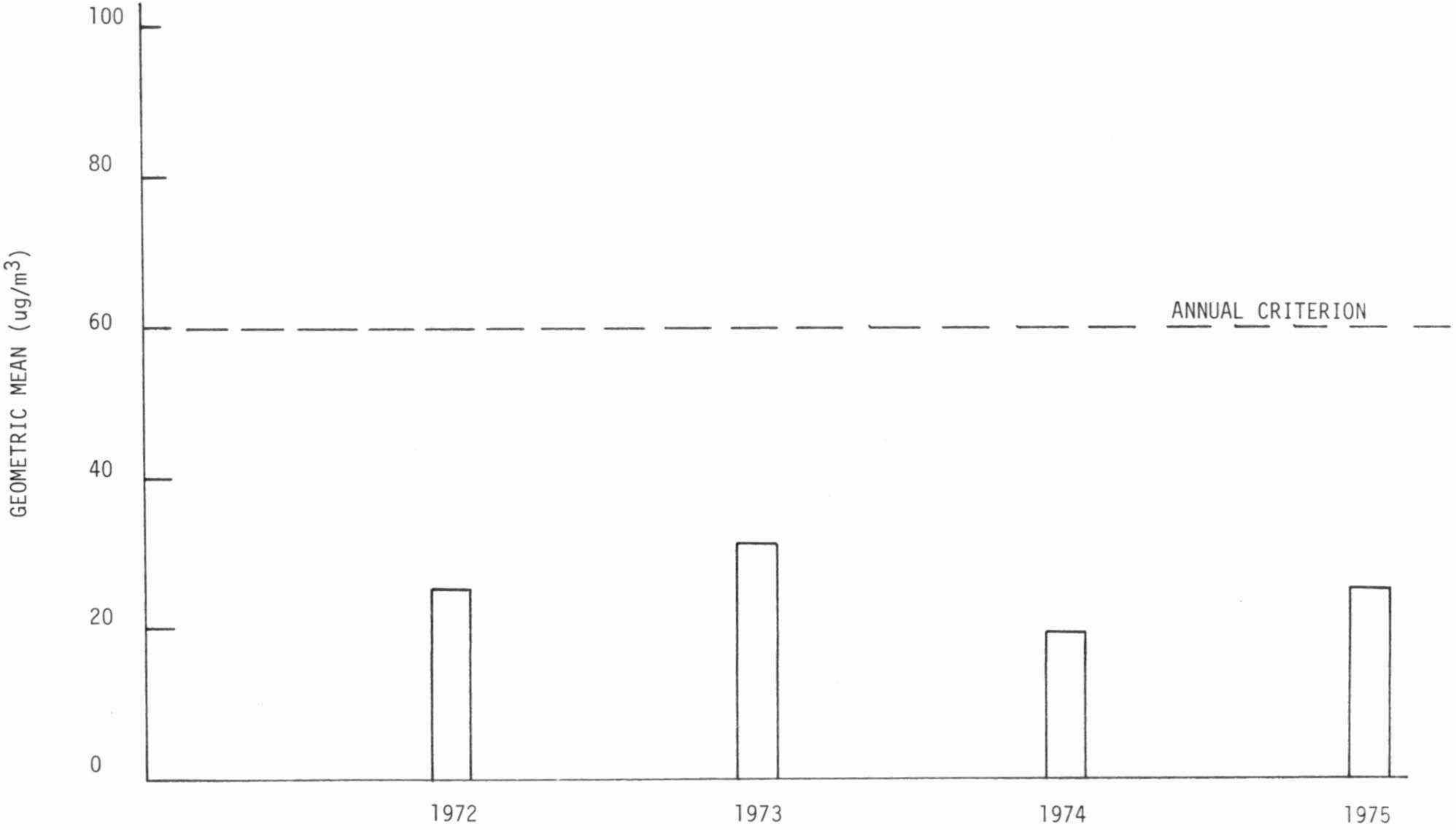
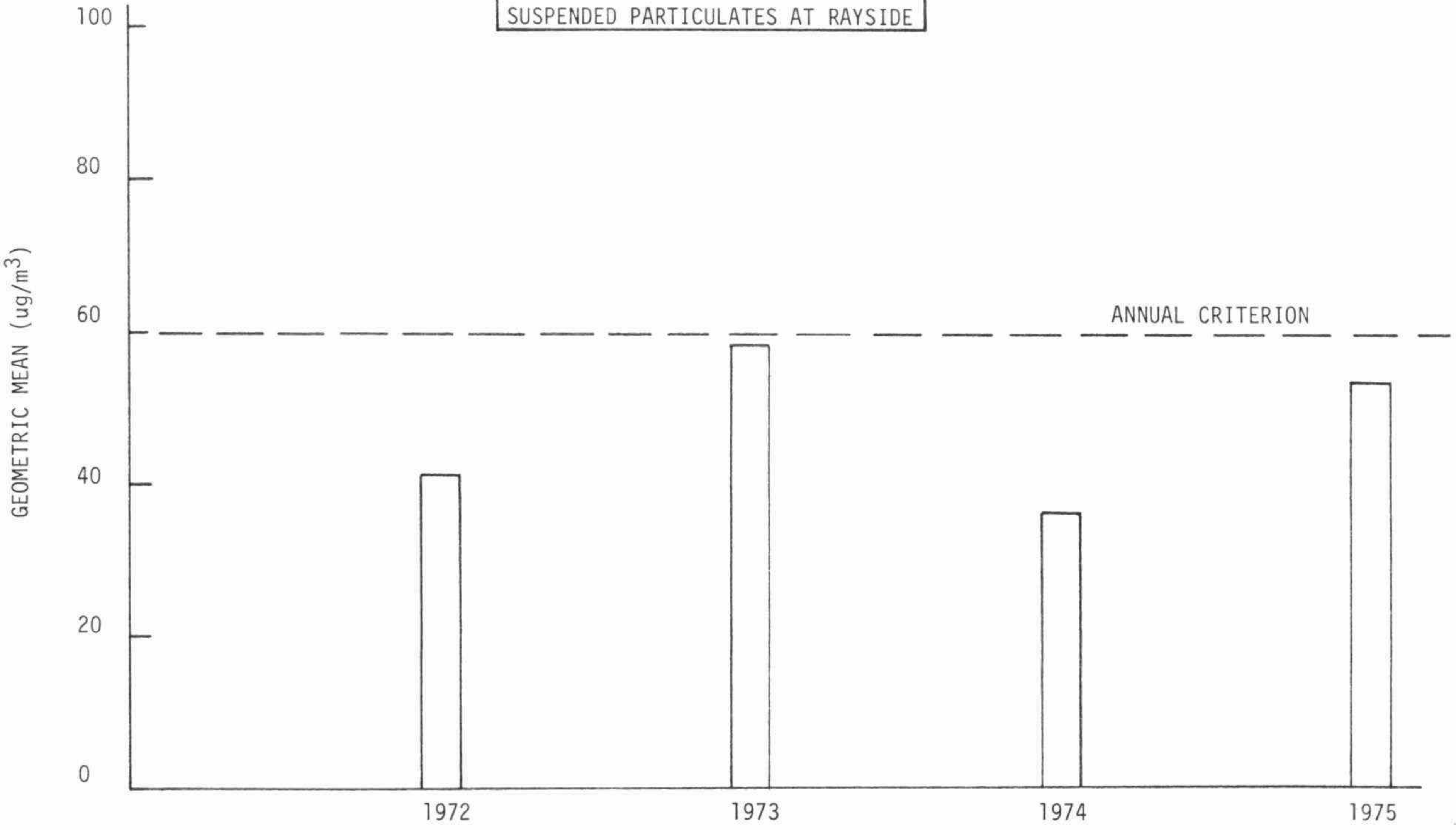


FIGURE 11
ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT RAYSIDE



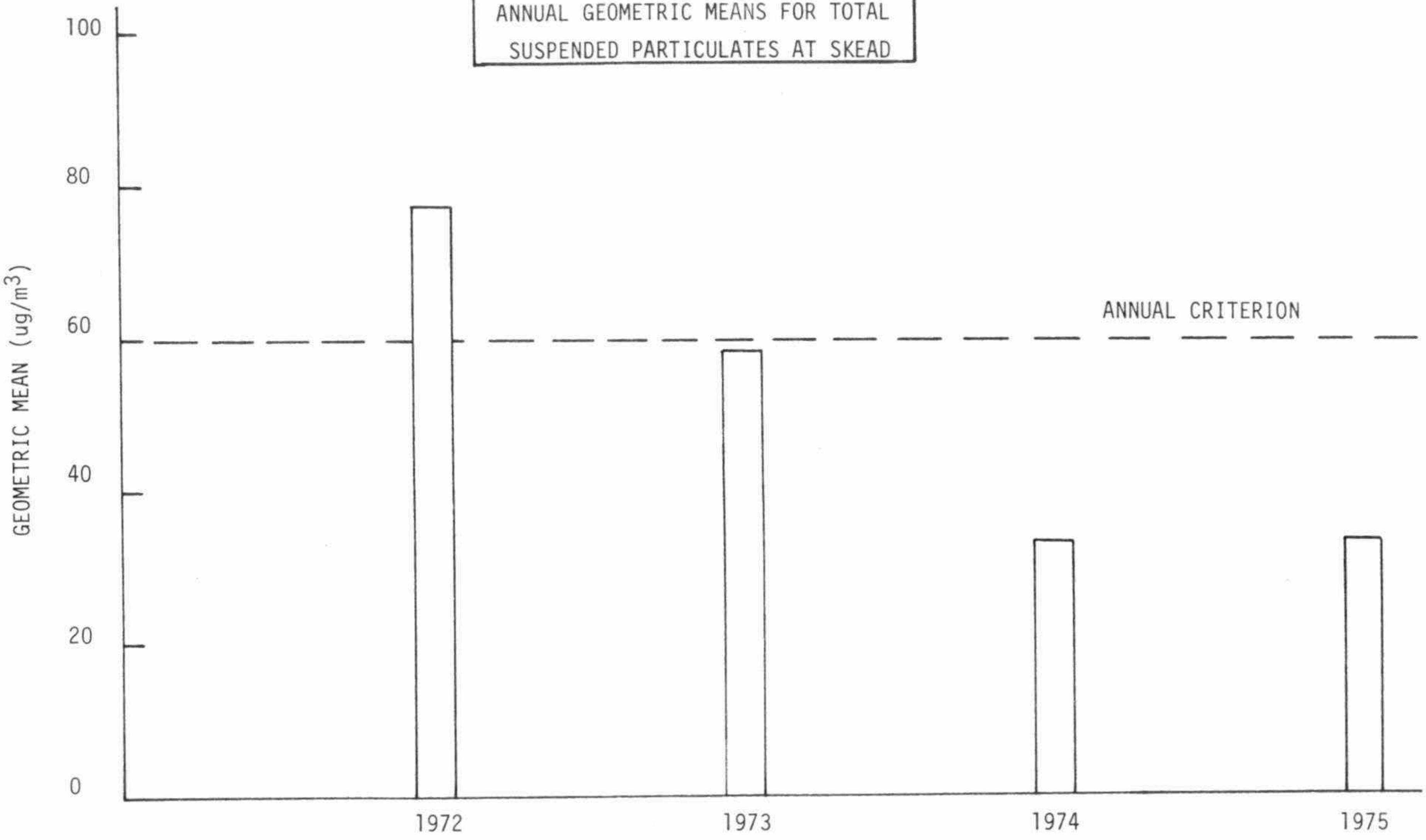


FIGURE 12
ANNUAL GEOMETRIC MEANS FOR TOTAL
SUSPENDED PARTICULATES AT SKEAD

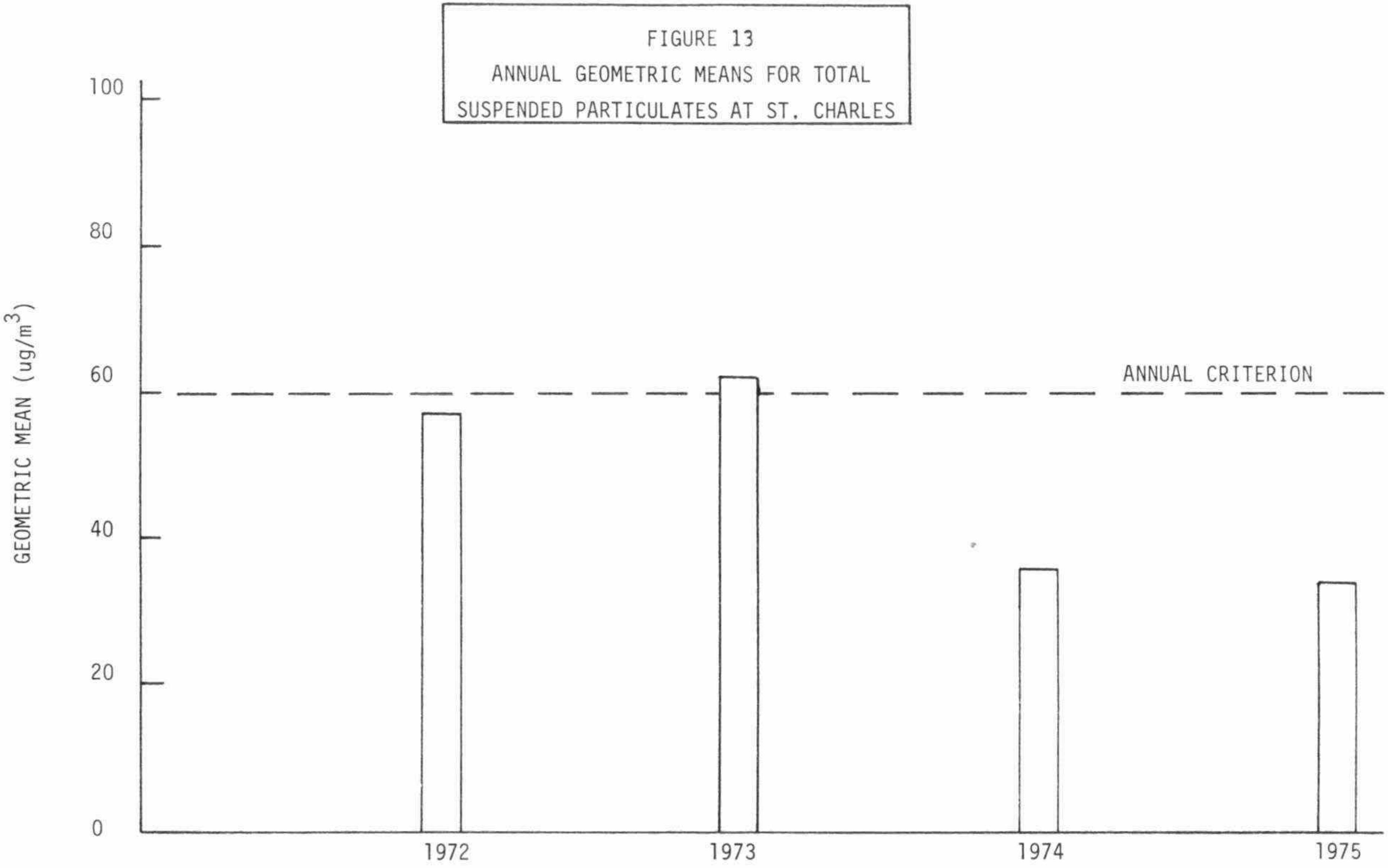


FIGURE 13
ANNUAL GEOMETRIC MEANS FOR TOTAL
SUSPENDED PARTICULATES AT ST. CHARLES

FIGURE 14

ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT ASH ST.

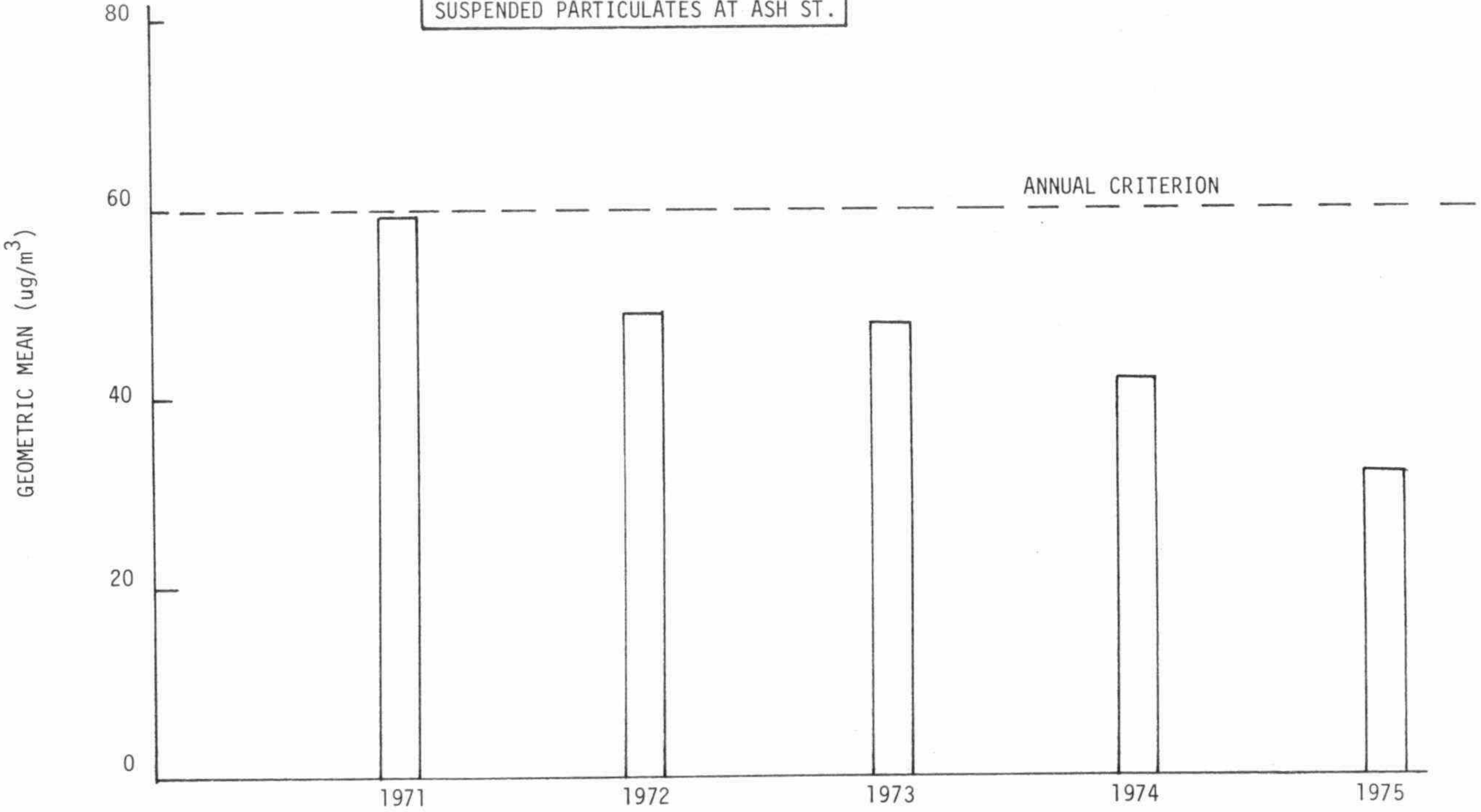


FIGURE 15

ANNUAL GEOMETRIC MEANS FOR TOTAL SUSPENDED PARTICULATES AT LISGAR STREET.

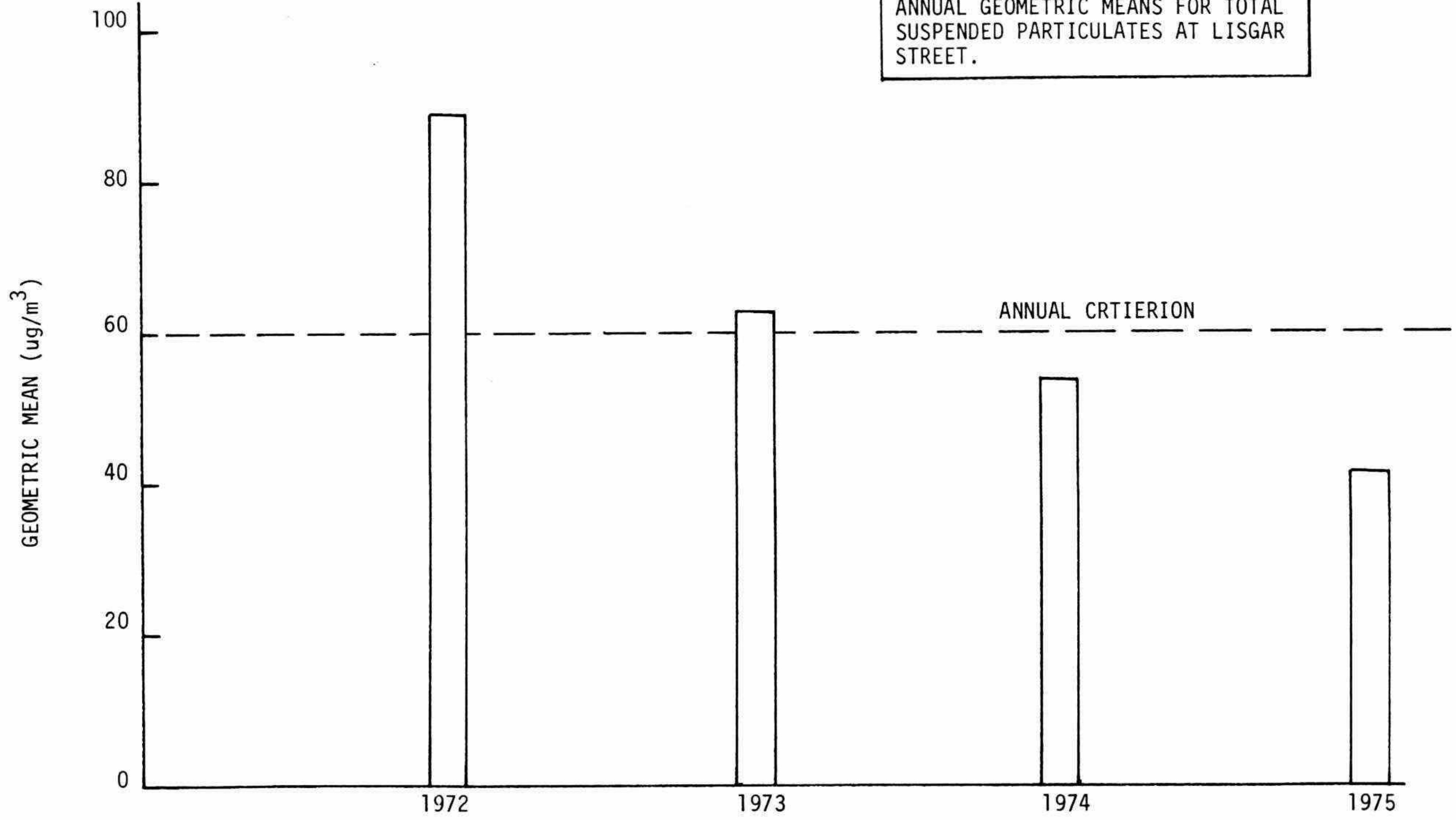


FIGURE 16

ANNUAL AVERAGE FLUORIDATION RATES AT ASH STREET AND LISGAR STREET

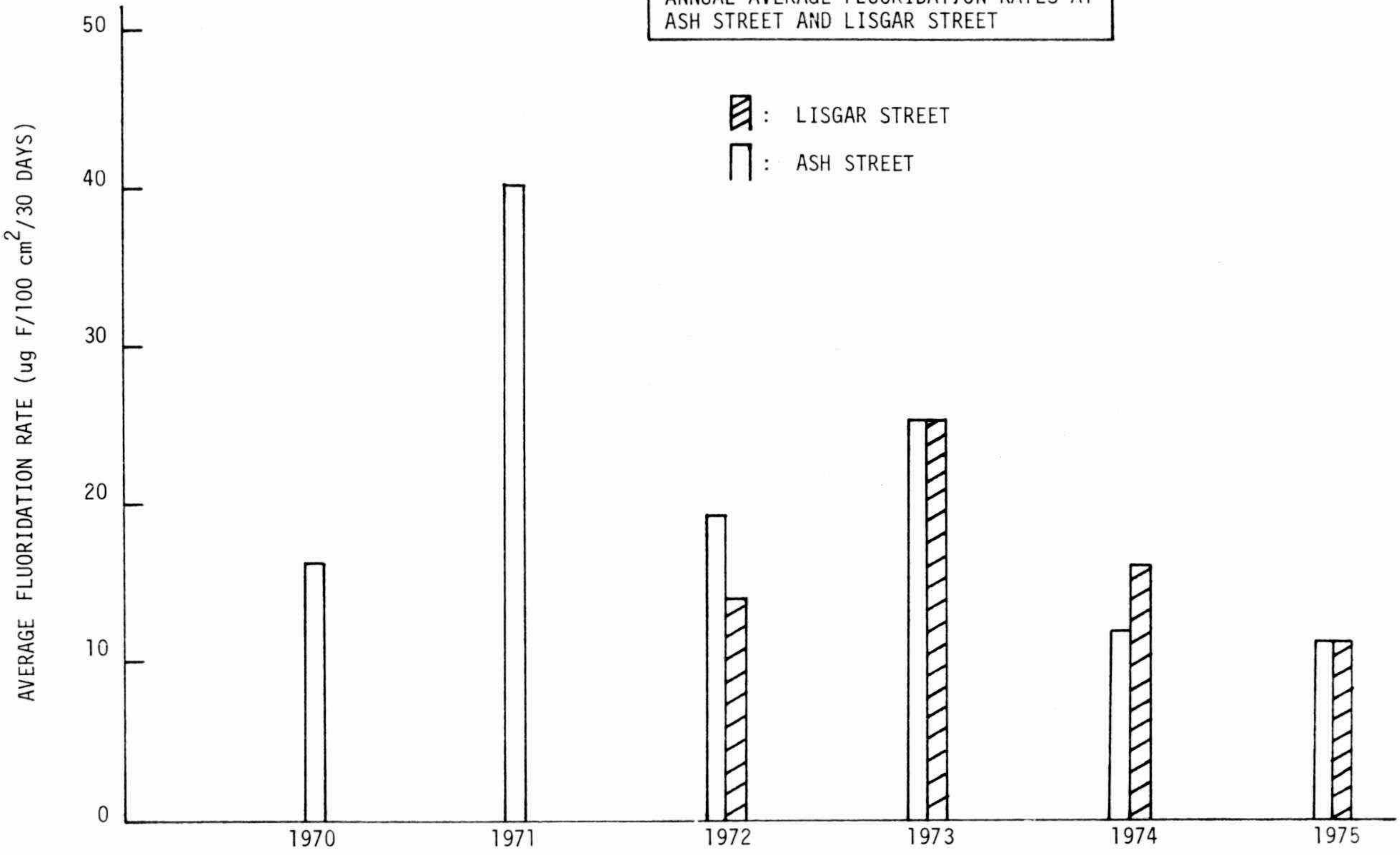
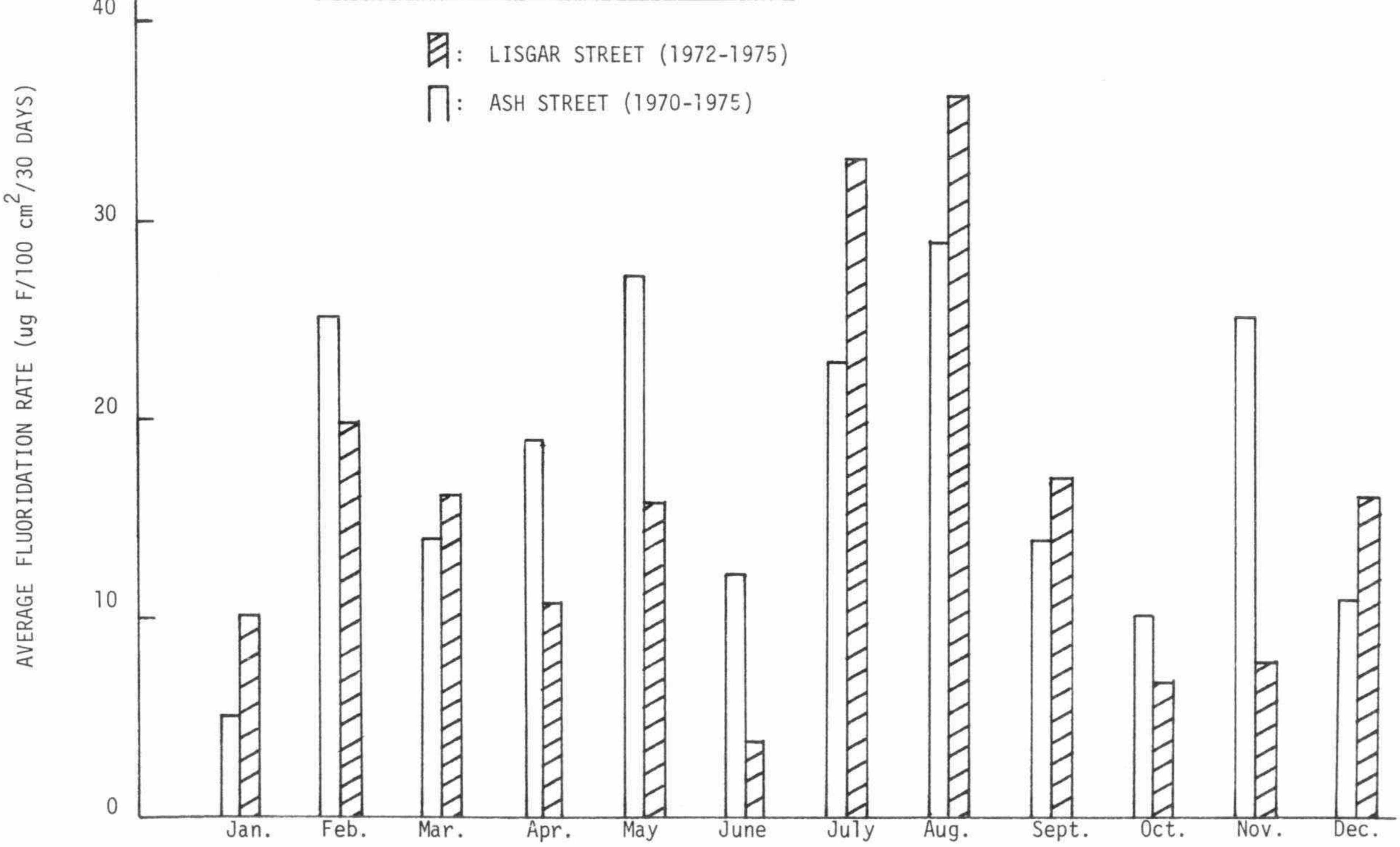


FIGURE 17

AVERAGE MONTHLY FLUORIDATION RATES AT ASH STREET AND LISGAR STREET



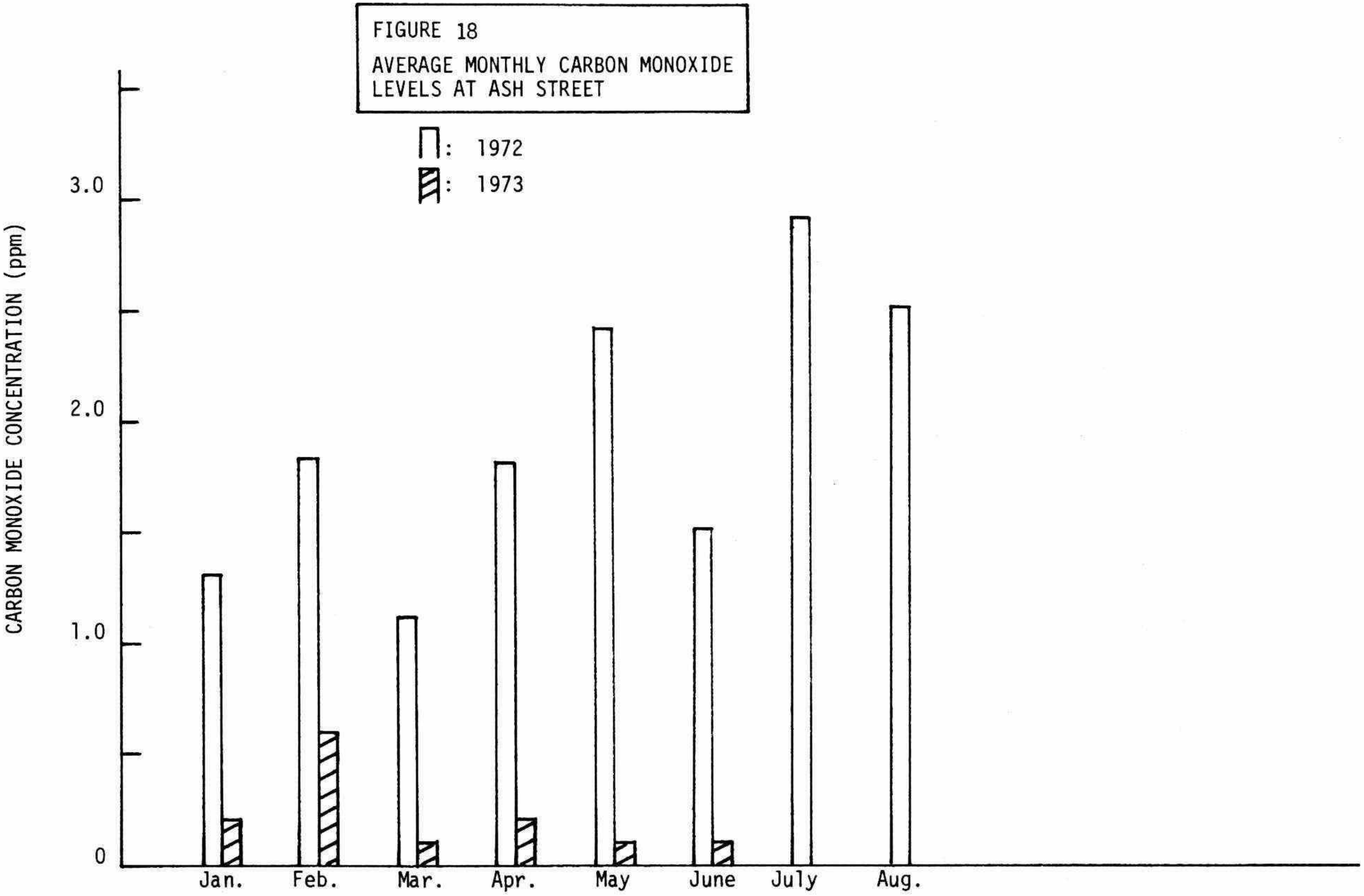


FIGURE 18

AVERAGE MONTHLY CARBON MONOXIDE LEVELS AT ASH STREET

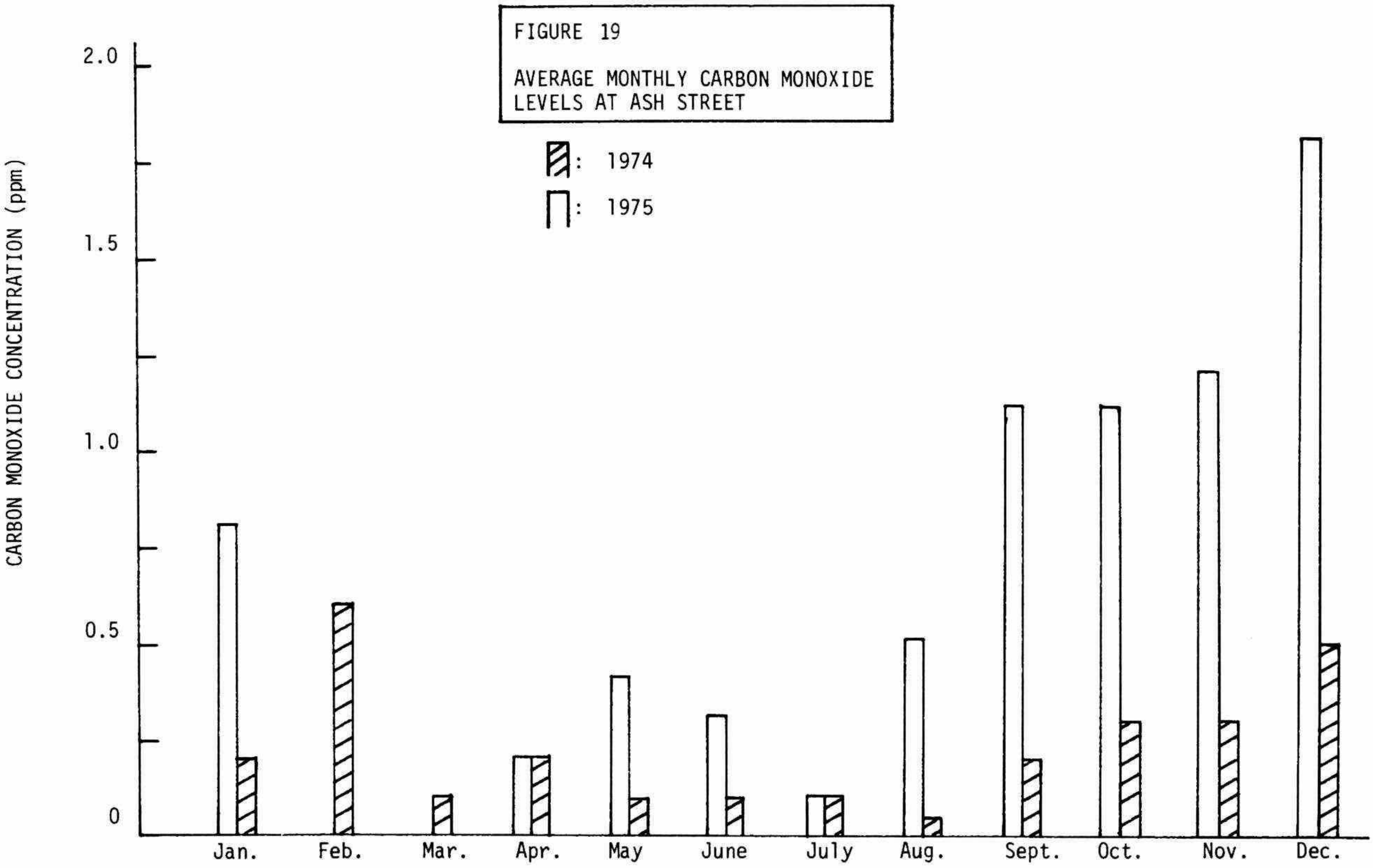


FIGURE 19

AVERAGE MONTHLY CARBON MONOXIDE LEVELS AT ASH STREET

FIGURE 20

ANNUAL HOURLY AVERAGE CARBON MONOXIDE LEVELS AT ASH STREET DURING 1975

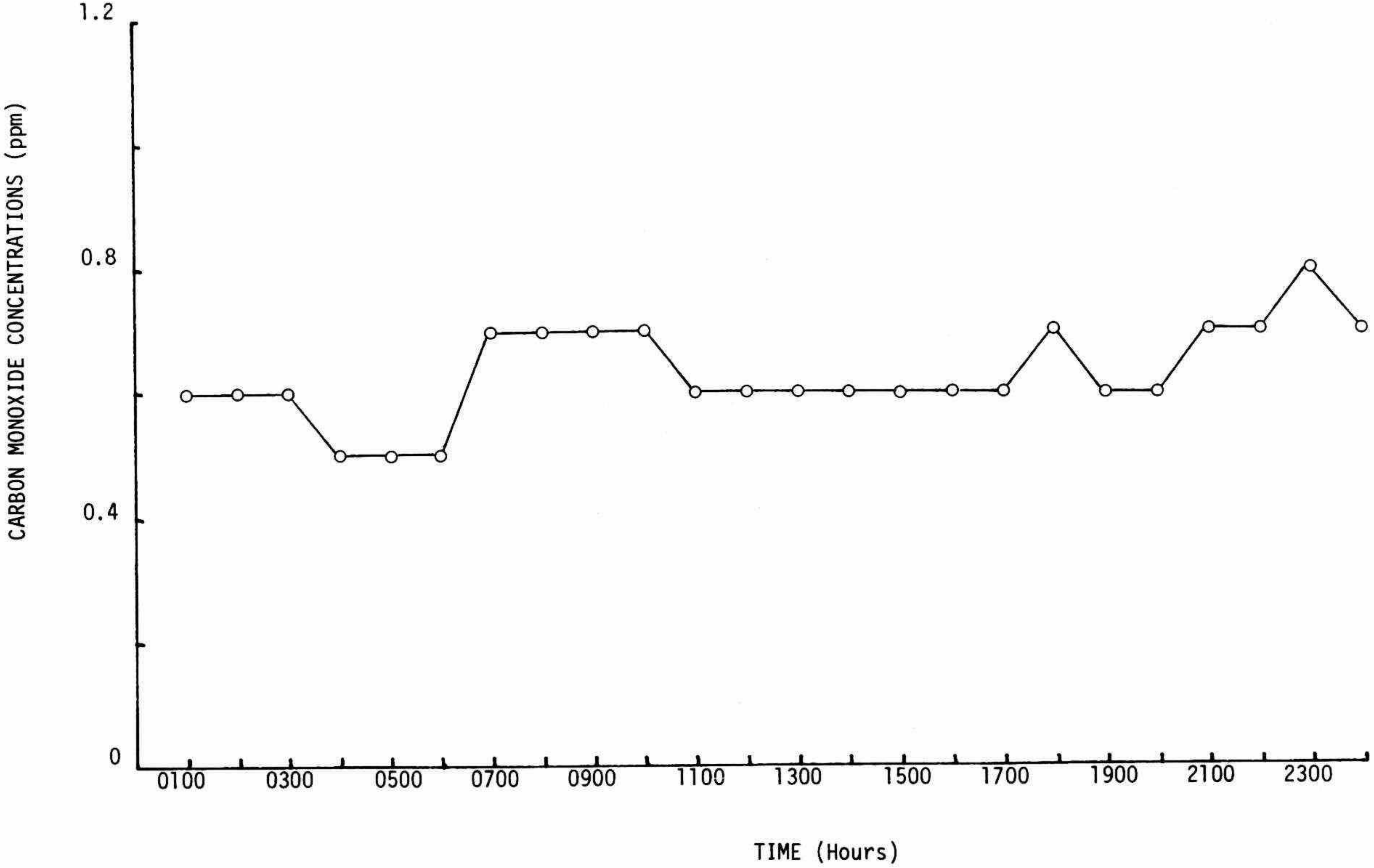
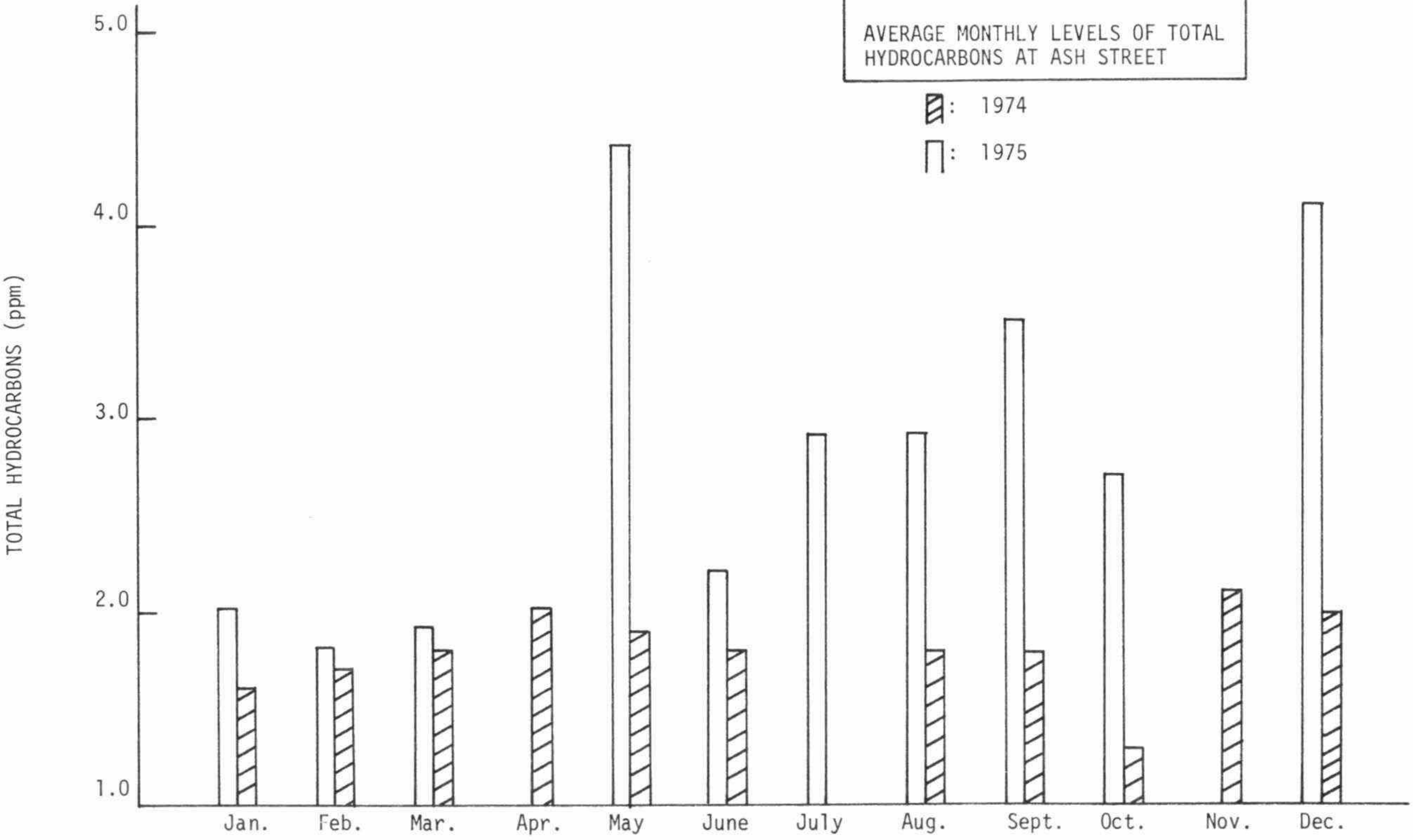


FIGURE 21

AVERAGE MONTHLY LEVELS OF TOTAL HYDROCARBONS AT ASH STREET



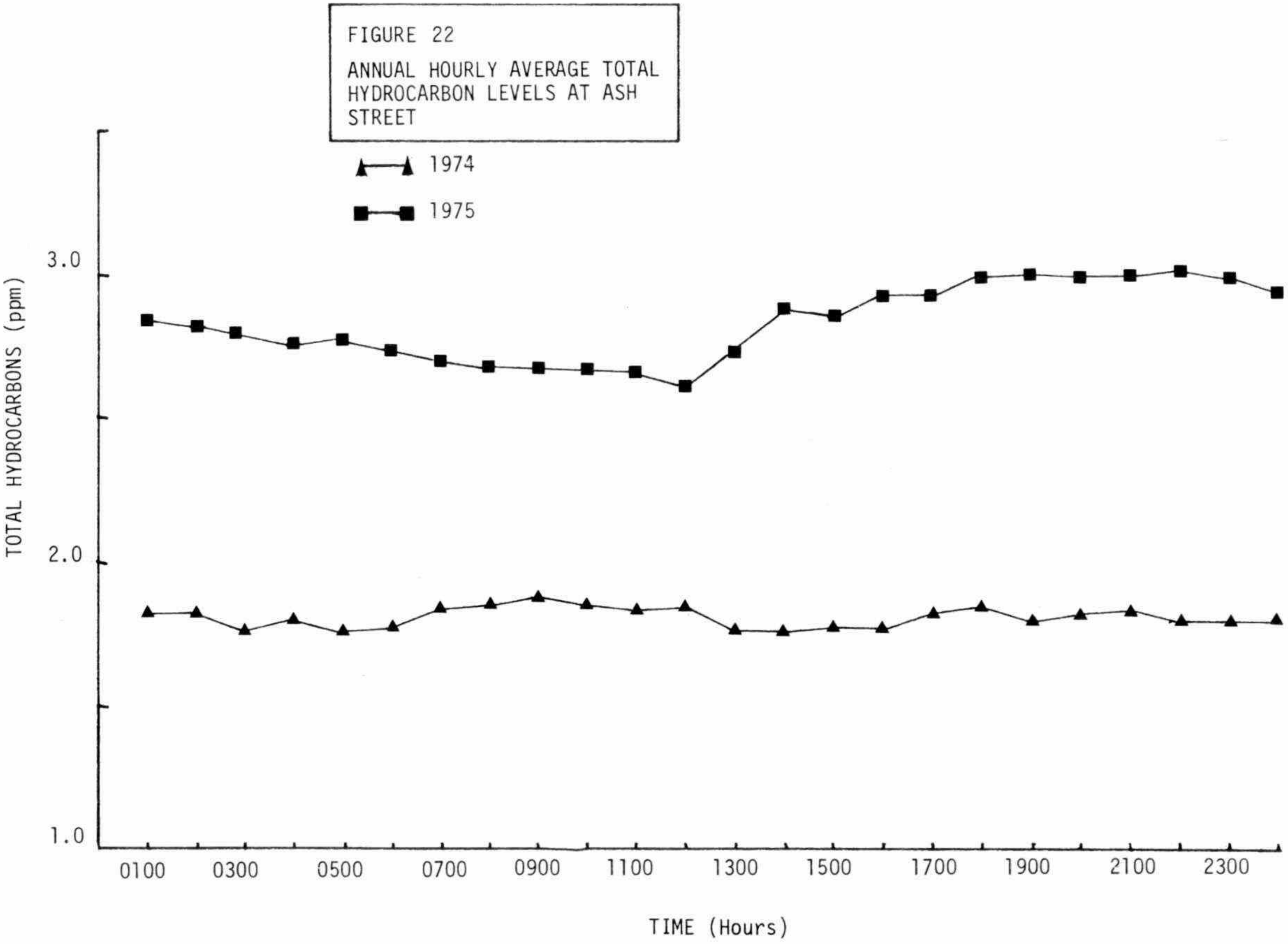
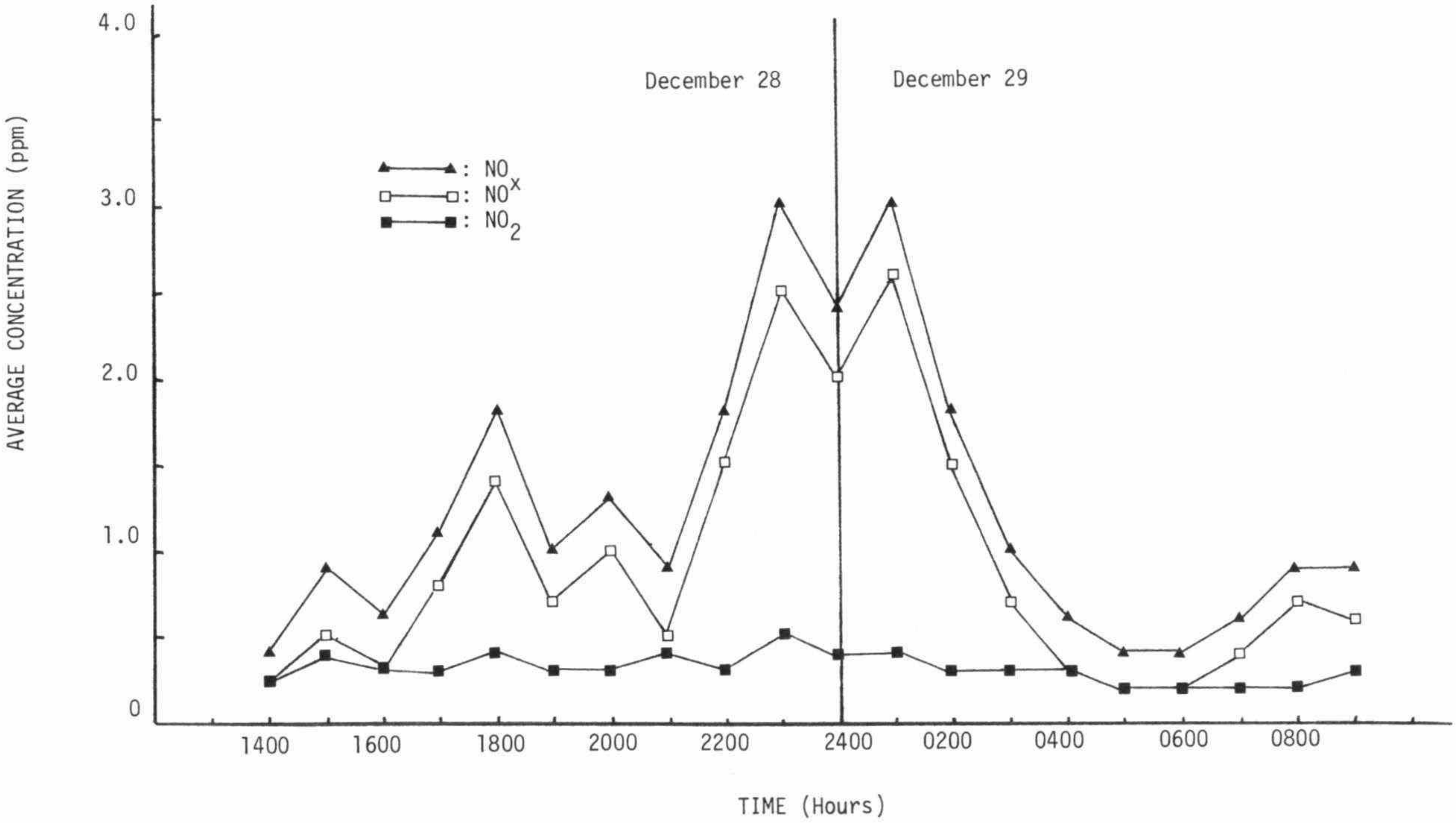


FIGURE 22

ANNUAL HOURLY AVERAGE TOTAL HYDROCARBON LEVELS AT ASH STREET

FIGURE 23

A TYPICAL NO_x EVENT AT ASH STREET IN DECEMBER 1975



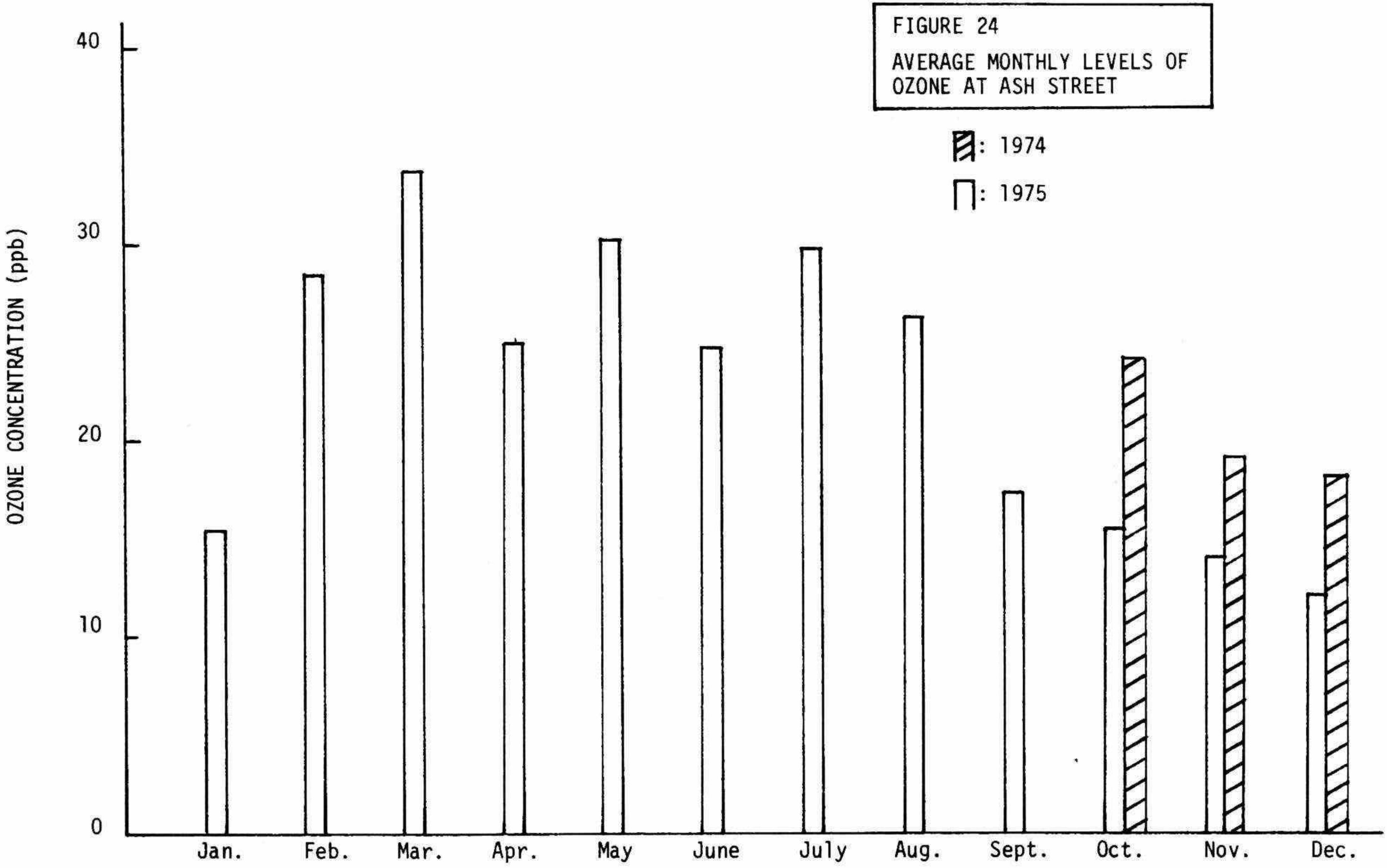


FIGURE 24

AVERAGE MONTHLY LEVELS OF OZONE AT ASH STREET

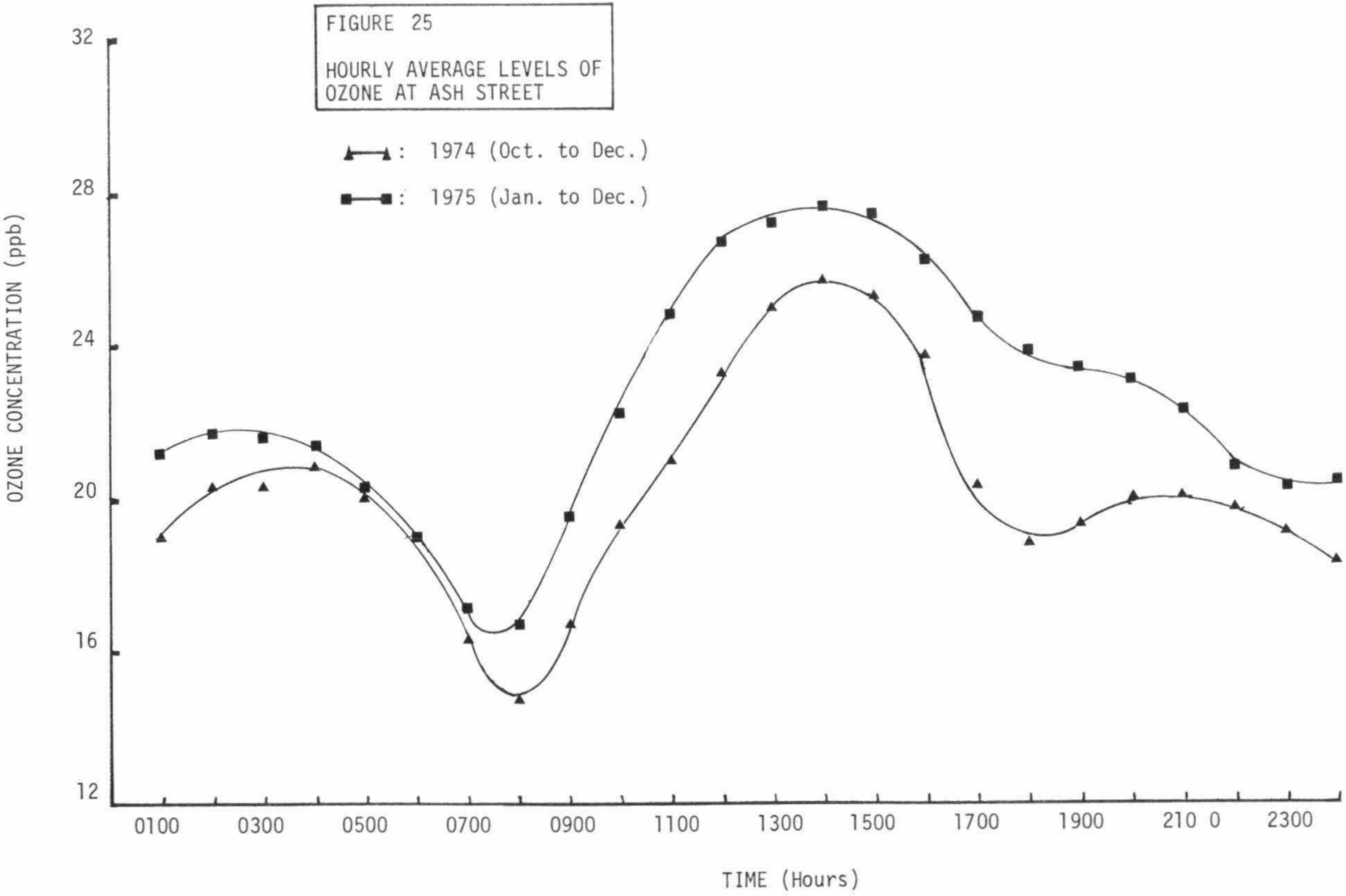


FIGURE 25

HOURLY AVERAGE LEVELS OF OZONE AT ASH STREET

TD
182.4
.O57
P57
1976